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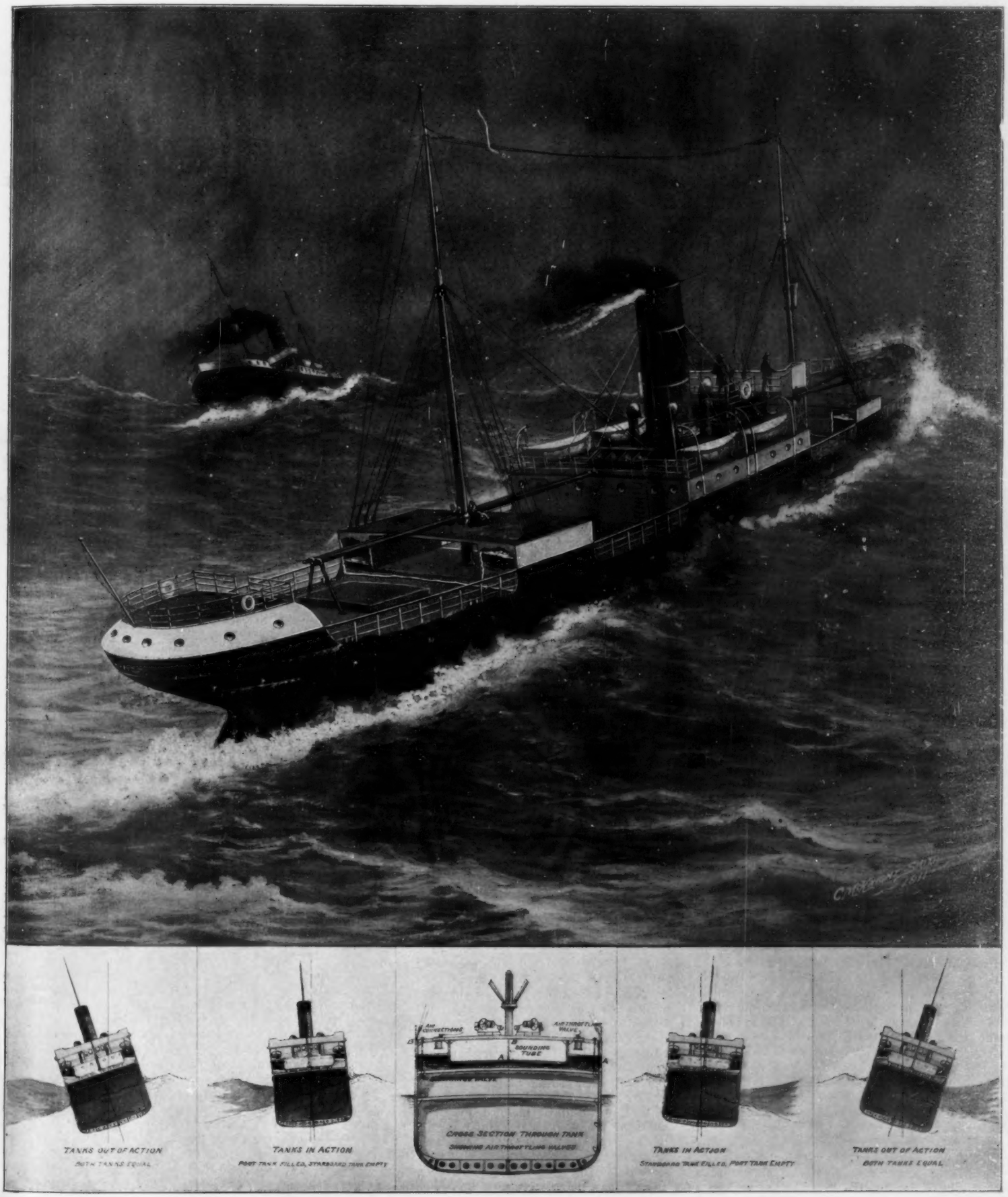

The device shown above embodies two water-filled tanks, one at each mast, consisting of large side chambers connected at the bottom by a shallow transverse passageway. The flow of water from side to side of the tanks is so far delayed that there is always a large excess of water on that side of the vessel upon which the sea wave is exerting its heeling effect.

ANTI-ROLLING TANKS FOR STEADYING SHIPS AT SEA.—[See page 502.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Flying in a Wind

SUPPLEMENTING our recent discussion of the conditions of flight in a wind, we wish to make it clear that the article was intended as a word of warning to the novice, and not to the experienced airman. Furthermore, lest the article should lead to confusion regarding the elementary laws of motion, we wish to emphasize the fact that once the aviator is clear of the ground, his maneuvers and all questions of momentum, speed, etc., are referred solely to the new medium, the air. Whether the air be in movement or not, need give him no concern whatever, except so far as regards those local disturbances, known as "pockets," "air holes," "boulders," etc. The risk in turning when flying against the wind might occur only when an aviator failed to distinguish between his velocity with regard to the air and his velocity with regard to the earth, and if, because he was moving slowly or not at all over the earth, he omitted, when making the turn, to bank his machine to the proper degree corresponding to his velocity through the air and the sharpness of the curve described by his aeroplane.

So far as the equilibrium of the machine is concerned, it makes no difference whatever (except for the local disturbances above mentioned) whether the atmosphere lies absolutely still above the earth or is moving over its surface at 100 miles per hour. If it were possible to build an automatic, unpiloted aeroplane, with controls that functioned perfectly in all the various evolutions, and it were started in flight over a rectangular or oval course, it would perform the various maneuvers with just as much certainty in a wind as it would in still air.

The danger to which we referred would be due entirely to the human element in the problem—to the fact that the aviator, particularly if he were a novice and making his first flight in a wind of strength, would be liable to refer his speed to the earth, and not, as he should, to the medium in which he was traveling—the air. It is quite possible that the well-known liability of the beginner to fall when making a turn out of the wind, is largely traceable to this error. As a matter of fact, in a machine flying at 40 miles per hour through the air against a 40-mile wind, and therefore having no speed with regard to the earth, conditions of equilibrium in turning will be exactly the same as if the same machine were flying at the same speed through still air. In each case, were it possible suddenly to reverse the aeroplane instead of turning it gradually in a circular path, its inertia would tend to carry it onward against the air in its first line of motion, according to the well-known law.

It was the Wright brothers who first clearly demonstrated the proper method of control in turning, namely, by adjusting the tilt of the machine so that its vertical projected area would cause the atmosphere to offer the horizontal resistance necessary to equilibrate the centrifugal force, and enable the machine to make the turn.

The qualified aviator knows that the proper degree of banking is determined by two factors, the speed and the sharpness of the curve. Experience has taught him just how far the increased air reaction on his outer wing surface should be permitted, under the control of his own warping devices, to bank his machine to suit the speed and the curve. Furthermore, he judges his speed strictly with regard to the air, and not with regard to the ground. Consequently, if he were creeping slowly up to a pylon, against a wind of nearly his own velocity, so that at the instant of turning, he was practically stationary, in putting his rudder over for a sharp turn, he would know enough to bank his aeroplane to the same degree as if he had rushed up to the pylon at 40 miles per hour in still air.

But how many of the newcomers, if we except those who have had instruction in a good aviation school, in making their first flight in a wind of strength, and approaching a turning mark at a speed over the earth of a few miles an hour, would know enough to bank their machines to the full extent required? If the pilot chanced to be a chauffeur who had recently turned aviator, by the very instincts of his former training, he would be liable to manipulate his aeroplane for slow speed conditions, and not for the full 40 or 50 miles per hour at which he was traveling through the air.

The homeliest illustrations are sometimes the best. That flight is concerned solely with the medium in which it takes place is proved in the case of a common house fly when it is flying, say, in a Pullman dining-car. Although the body of air within the car may be traveling at 70 miles an hour over the earth, the motions of the fly will be made with the same freedom as they would were it flying in the stationary air within the café of a city hotel.

The aviator, then, is concerned solely with his movement through the air; he has no concern whatever with the motion of the whole body of air itself, whether that motion be over the face of the earth as a 40-mile wind, or around the earth's center at 1,000 miles an hour as part of the atmospheric belt, or around the sun at 66,000 miles per hour in the path of the earth's orbital movement.

We spoke above of a sudden reversal of the machine in a wind. As a matter of fact, this would be impossible. But if it could be done without the interposition of a properly banked turn, the machine, for the few moments before it fell, would be moving tail first against the wind. The same result would follow if a sudden reversal, without the usual turn, could be made when flying in still air—the machine would tend to move onward in the line of its original flight. Both in a wind and in still air, the conditions would be identical. The change in velocity would in the first case be from zero to minus 80 miles per hour, and in the second from plus 40 to minus 40, again a total change of velocity of 80 miles per hour.

In conclusion, we would point out that the supposed difference between the dynamics of flight in a wind and in still air will vanish if we bear in mind that while the *gravity* of an aeroplane in flight is referable to the earth, its *inertia*, as affecting changes of motion, is not in any sense referable to the earth, being, in fact, an inherent property of the machine itself. An engineer who has been accustomed, in calculating problems of train acceleration and retardation, to refer velocities to the earth, is apt, at first thought and through sheer force of habit, to retain the same reference point in considering, for the first time, the velocities of an aeroplane in the air. The reference point, we repeat, is no longer the earth, but the air itself.

Chutes as Fire Escapes

A CORRESPONDENT in New Jersey writes to ask if we will not give our opinion as to the life-saving value of chutes, properly installed in factories, department stores or other buildings that are crowded with occupants. We gladly do so; for we believe that in simplicity, safety and capacity to handle large numbers of people, the chute offers the very best means of escape for a panic stricken crowd.

The chute form of fire escape consists of a smooth, metal-lined, inclined plane, of sufficient width to permit the passage of several persons, and whose inclination is such as to insure that gravity will carry the body safely and surely to the upcurved landing at the bottom. For factory buildings it has the advantage that the occupants are perfectly familiar with its operation, and will not hesitate to trust themselves to the descent; for the chute is one of the most popular forms of entertainment among those factory operatives who probably constitute the majority of the holiday crowds at such places as Coney Island.

The question of finding the necessary space for a sufficient number of chutes to handle the population of a crowded building is not so difficult as might at first thought appear. The most practicable chute would be that which consists of a spiral slide inclosed within a tube. The tube need be only a few feet in diameter; and it would be possible to erect several of these against the inner walls that front upon the central court or well. In cases where this was not practical, a separate fire tower, occupying the space now given over to the treacherous stairways, and shut off from the main building by iron doors, could be utilized for the erection of the chutes.

The speculative builder, it is true, might raise objections on the score that too much valuable space would be required for such devices; but we dare to believe that the growth of humanitarian considerations has reached such a point that, if the building departments of our cities were to make the provision of commodious fire towers an indispensable requirement of the building laws, they would be enthusiastically backed up by public opinion.

The chute is the ideal fire escape. The present exterior fire escapes are liable to be cut off by flame, smoke or asphyxiating gases; the same causes may shut off the elevators; interior stairways may be blocked; but the chute inclosed in its metal tube and built within a fire-protected tower, offers a certain escape to the ground of every occupant that may reach its upper entrance.

Of Nation-wide Importance

THE passage by the New York Legislature of the bill commanding the Board of Estimate of New York City, at the behest of the Supreme Court justices, to provide funds for a County Court House in City Hall Park, is a blow against the principle of city home rule, which has a significance that should commend it to the careful attention of every municipality within the United States. The city authorities are the proper officials to determine what buildings shall be erected, and where, and how their cost shall be met. Furthermore, this bill is highly pernicious in its effect upon that long-delayed but greatly-needed awakening to the importance of the question of the architectural and general aesthetic appearance of American cities. The "city beautiful" is no mere dream of the enthusiast, and the recent awakening of the public to the necessity for preserving such parks and open plazas as we have, and of erecting future public buildings upon some carefully co-ordinated plan, is one of the most encouraging signs of the times.

Not many months ago, the Supreme Court justices who compose the Court House Board, selected City Hall Park for the erection of a huge court house, whose towering mass would have encroached sadly upon the all-too-limited area of the park, and would have reduced to insignificance the classic and beautiful City Hall—the one perfect architectural gem among the public buildings of this city.

There is no mistaking the genuine character of the outburst of public disapproval of the proposed plan, and the popular indorsement of the substitute scheme for the development of a noble civic center by the purchase of the blocks immediately north of the City Hall and the erection thereon of the proposed Court House and such other municipal buildings as might from time to time be approved.

The present bill is deplorable, look at it from whatever standpoint we will. Not alone does it fly in the very teeth of precedent and the public will; not alone does it exhibit a contemptuous disregard for the professional knowledge and public-spirited efforts of the leading architects of the country, but it establishes a subversive principle by charging our judges, "whose business it is to judge and not to execute," as the New York *Times* very aptly remarks, with the execution of public works. Moreover, it is safe to say that if the Supreme Court justices, who compose the Court House Board, should take any executive action under the provisions of this measure, they will do so reluctantly, knowing full well that their action is liable to ultimate reversal in the Court of Appeals. Never were the wishes of the citizens of New York made known with clearer emphasis than upon this question of the preservation of City Hall Park. We can conceive of no legislative matter upon which the Governor of the State could more safely exercise his power of veto.

Vacant Regions in the Milky Way

Herschel's "Windows of Heaven"

By Mary Proctor

THAT vacant regions of apparently absolute darkness prevail amid the luminous clouds of stars in the Milky Way has been shown by the photographs taken by Prof. E. E. Barnard of the Yerkes Observatory. In these marvelous galactic landscapes, bright, cloud-like masses furrowed by dark rifts and dusky lanes are revealed, indicating seemingly the eventual breaking up of the material forming the Milky Way into many small but independent nebulæ. According to the theory of Sir William Herschel, these black openings amid the starry regions of the Galaxy denote the ravages of time and are among the most impressive of celestial phenomena. "Hier ist wahrhaftig ein Loch im Himmel" (Here, truly, is a hole in the sky), he is said to have remarked to his sister Caroline, when, after a long, awful silence, he concluded his examination of a black opening four degrees wide, in the constellation of the Scorpion. It was specially remarkable, as it bordered on the west of an exceedingly compact cluster (Messier's No. 80), possibly formed, he thought, by stars drawn from the adjacent vacancy. The chasm was to him one of the most impressive of celestial phenomena. Night after night, and year after year, he returned to the study of this strange dark abyss without ever clearing up the mystery of its origin.

Since the days of Herschel, we have become more familiar with the peculiarities of these vacant regions in the star depths, by means of the photographs obtained by Prof. Barnard. Yet we are not much nearer the solution of the problem concerning these gloomy deserts of the sky. Are they actual rifts amid dense layers of stars, the "Windows of Heaven," as Herschel termed them, giving us a glimpse of the immensity of space beyond; or are these dark spaces in the sky due to absorbing matter between us and the stars? According to the theory advanced by Prof. Barnard, such matter must, in many cases, be perfectly opaque, for in certain parts of the sky the stars are apparently blotted out. Elsewhere we see them dimly as through a veil, as though a vast nebulous mass drifted between us and the stars. "It is hard to believe in the existence of such matter on such a tremendous scale as is implied by the photographs. As to its nature, if it does exist," according to Prof. Barnard, "it must be in some way related to the nebulæ, for we find them in most cases to be intimately connected. Is it an ultimate condition of nebulous matter, or is it something wholly different from the ordinary nebulosity of the sky?" It is believed stars run through their various stages of brightness, until in the course of their career they fade from view, drifting like black cinders through space, undetected save where the spectroscope betrays their influence on glowing suns. In like manner the nebulæ may run their course during vast æons of time, drifting like derelicts along the Silver River of Heaven, as the Milky Way has been fancifully termed by the Japanese. "The dying out of nebulæ," says Prof. Barnard, "is a probability fully as warranted as the belief and certainty that the stars must die."

Photographed by Prof. E. E. Barnard.

The remarkable dark vacancies north of the star Theta Ophiuchi.

This photograph was made with the 10-inch Bruce telescope of Yerkes Observatory on May 8th, 1905. The plate was exposed three hours and thirty minutes.

The frequency of the black openings in the Milky Way, dimly seen with the naked eye in some cases, constitutes one of the most important facts, confirming their appearance as tested by the camera. An admirable delineation of a doubly perforated star-cloud, which forms part of the vivid scenery of the Milky Way in Sagittarius, was completed at Parsonstown in 1889, by Dr. Otto Boeddicker, after five years of labor. The result was a drawing showing a curious blending of clouds of stars interspersed with dark rifts, separated by luminous wisps and tendrils, as though a celestial breeze had wafted them apart. Pointed arches, intricate passages, and key-hole apertures enhanced the general effect, which was all the more remarkable, as feelers were observed which reached outward toward nebulæ and clusters and intertwined themselves around outlying stars like tendrils clinging around a vine. Nevertheless, these visual records of barely perceptible details, in the Milky Way, cannot begin to compare in value with the elaborate wealth of detail shown in the photographs of this region obtained by Prof. Barnard.

In a paper read before the Astronomical and Physical Society, December, 1905, entitled "Vacant Regions of the Sky," he gave the following account of a small star cloud in Sagittarius which can be readily seen with the naked eye: "The photographs show this cloud to be specially remarkable for two black holes in its upper part. The east side of the larger hole is very sharply defined, the cutting off of the stars and the apparently feeble nebulous light is remarkably abrupt, as if someone had drawn its outline with a brush and black paint. The west side of the hole shoals slowly and is not abrupt. So definite is this spot that several astronomers have thought that it may not really be a hole, and that it is perhaps an opaque mass of some sort that cuts off the light from this part of the Milky Way, against which it is seen in black relief. My own opinion is that it is a true hole through which we look out into space beyond where there are no more stars. In the hole is a conspicuous star which has a small attendant preceding. There are one or two other minute stars in the hole."

Another photograph taken of a "long, dull vacancy" visible to the naked eye, in a region near Theta Ophiuchi, resolves itself by means of the camera, into an irregular rift almost encircling the bright mass within which the star is placed. Furrowing lanes for itself through the nebulous star mist north of Theta, and straggling westward to the edge of the photographic plate, it finally connects with vacant regions of the sky in the neighborhood of Rho Ophiuchi. This is a fine but wide double star, and in speaking of it, Sir John Herschel describes it as being on "an intensely black background in a great blank space." The latter

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Photographed by Prof. E. E. Barnard.

The vacant lanes between Rho and Theta Ophiuchi.

This photograph was made on June 3rd, 1905, and plate was exposed exactly four hours. The instrument used was the 10-inch Bruce telescope of the Yerkes Observatory.

The great nebula of Rho Ophiuchi and the vacant lanes.

This picture was made on April 5th, 1905, with the 10-inch Bruce telescope of Yerkes Observatory. The exposure was four hours and thirty minutes.

HOLES IN THE SKY

Measuring the Deviation of Bore Holes

By J. F. Springer

THE newer systems of drilling holes into the earth, while wonderfully effective as to the boring operation proper, have manifested a rather peculiar kind of errancy in that they deviate from the vertical. Under the older system, when a heavy chisel-like tool is alternately lifted and dropped, the hole could, it would seem, scarcely be anything but vertical. In such methods as the chilled shot and diamond systems of drilling, where a metal rod is the instrument of bering, it would seem unlikely that anything more than a very minute deviation could occur. Let it be remembered that in these systems the drilling is effected by rotating the drill rod. It seems almost incredible to suppose it possible to rotate such a rod in a bent hole. But whether we understand it or not, the fact itself is well ascertained. One cannot, perhaps, give assent to any such story as that of the man who drilled and drilled in from a point in his own mining claim until the bit came up on that of his neighbor. Regarding this as apocryphal, we still have reliable accounts such as follows:

Twenty-three holes were sunk by drilling in the northern part of France in a circle of small radius. Four of these deviated nearly one foot for every fifty feet of depth until a level of 280 feet below the surface was reached. In another case, it was desired to sink a drill hole along the axis of a shaft four feet in radius. When a depth of 72 feet had been reached the deviation had carried the hole out at the side so that it was no longer serviceable for the purpose of drainage, which was the object sought. This amounts to a deviation of 1 foot in 18. A hole 750 feet deep was put down in Germany and developed a deviation amounting to 47 degrees. This hole was bored by means of a turning bore and iron rods. A hole put down in South Africa to a depth of 4,802 feet deviated the enormous amount of 2,185 feet. This is not as great an angular deviation as in the last case, but the depth here was great. All this may seem merely interesting and curious to those of us who are not engaged in sinking exploratory bore holes. To the parties most concerned, however, it is a matter of trial and difficulty. Thus, in the case where the deviation of 47 degrees developed, it seemed useless to attempt to proceed after the facts became known. The boremaster had claimed the hole to be perfectly vertical. In fact, however, it was 2 degrees out at a depth of 200 feet, 3¾ degrees at 300 feet, 8¼ degrees at 430 feet, and 47 degrees at 750 feet. It will be seen from this that the deviation may occur without warning. In this case a deviation of 38¾ degrees occured in the final 320 feet.

It will be interesting to know just how these deviations were ascertained. The instrument employed was of the following character. A glass tube having a bottom perpendicular to its sides is filled half full of an aqueous solution of hydrofluoric acid, 20 per cent strong. This chemical has the quality of etching or eating away the glass, while at the same time leaving it transparent. If the tube containing the acid be now lowered into the bore hole, a more or less regular etching will take place due to oscillation. It will be easy to disregard this and also that consequent upon raising the tube, because of the absence of any deep marginal ridge in any direction. The instrument containing the tube is, however, allowed to remain a considerable time at the depth at which the inclination is desired. There will result a deep ridge, which may be sufficient to be felt by the fingers. When the tube has been recovered, it may quickly be placed upon a level surface after having poured out a little of the liquid, and allowed to stand. A second ridge will now be formed. The angle between the planes of these ridges will be the angle of deviation from the perpendicular at the point when the pause of half an hour occurred. To calculate this angle the distance apart of the two ridges at maximum and minimum approach are determined. The difference is the one side of a right

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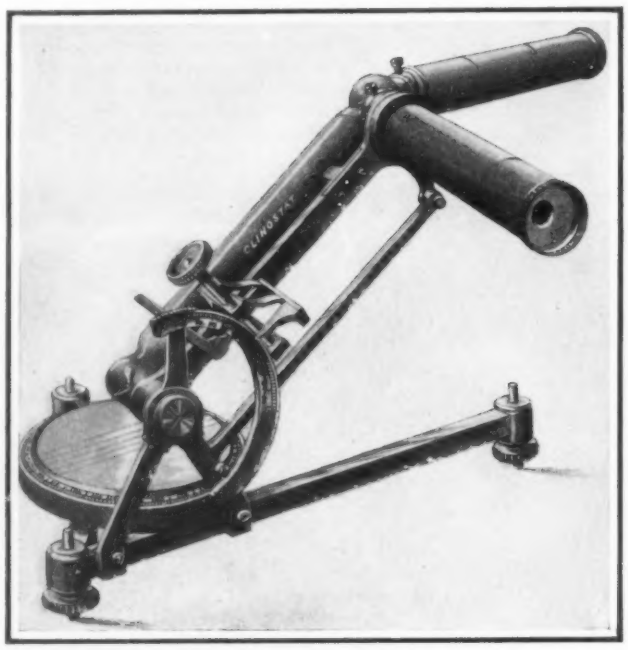

THE MACGEORGE CLINOMETER

An instrument for determining the deviation of bore holes from the vertical.

Curious History of a Great Obelisk

By Deshler Welch

THE great obelisk that stands on the piazza in front of St. Peter's in Rome has a history that involves in its record more of the circumstances of war and pomp, traditions of romance, and melodramatic glamor than anything that has been handed down concerning any one of the other forty-eight Egyptian obelisks still in existence.

These mighty shafts, quarried from red granite, or syenite, and a few of hard sandstone, were erected by the sun-worshiping Egyptians as a figure representing a ray, or a pencil of light. The sun was the god "Ra," and appeared upon the monuments and on the papyri under various forms. The greatest monuments representing "Ra" were the obelisk and the pyramid; the latter symbolical of the setting sun—darkness and death. The obelisk as the ray or needle of light seems to be like the uplifted pyramid seeking penetration, for its cap bears the pyramidical shape, and so in melancholy distinction the pyramid appears to be the top of it sunken low in the desert sands.

Of the forty-eight remaining out of the hundred that were doubtless placed by Thothmes III. and Rameses II., ten are lying prostrate and thirty-eight are thus distributed—nine in Egypt, two in Constantinople, twelve in Rome, six in Naples and other parts of Italy, two in France, four in England, two in Germany, and one in the United States, whose recent history as told in the tremendous task undertaken by Commander Gorringe of the navy to bring it from Egypt and place it in Central Park in New York city, was full of strenuous and interesting detail. But the history of all these obelisks can be obtained from a vast array of bibliography, much of which is still to be translated from the Italian and French records—particularly from Fontana in his "Della trasportatione del Obelischo Vaticano" (1500) and "A History of Obelisks" by L'Hote (Paris, 1836). There was one obelisk erected in Heliopolis by Usertesen I. between 2758 and 2714 B. C. that still exists. All of these shafts are more or less covered by hieroglyphics, excepting the one in front of St. Peter's, which is bare.

The largest obelisk is on the piazza of St. John Lateran in Rome. It was brought from Thebes to Alexandria about 230 A. D. by Constantine the Great, and thence to Rome by Constantine, who placed it in the Circus Maximus. It measures in height 108 feet and 7 inches and weighs 455 tons. On the fall of Rome it was broken in three pieces and lay neglected on the ground until Pope Sixtus had it taken from the ruins and restored in 1588. The obelisk in Central Park is 69 feet 6 inches nigh, nearly 8 feet square at the base and weighs 448,000 pounds, or 224 tons. The London obelisk is 68 feet 5 inches high, 7 by 8 feet at the base and weighs 209 tons.

The "St. Peter's Obelisk" was estimated by Fontana to weigh 320 tons. It was brought from Heliopolis to Rome by Caligula and placed in the Vatican (or Nero) Circus,

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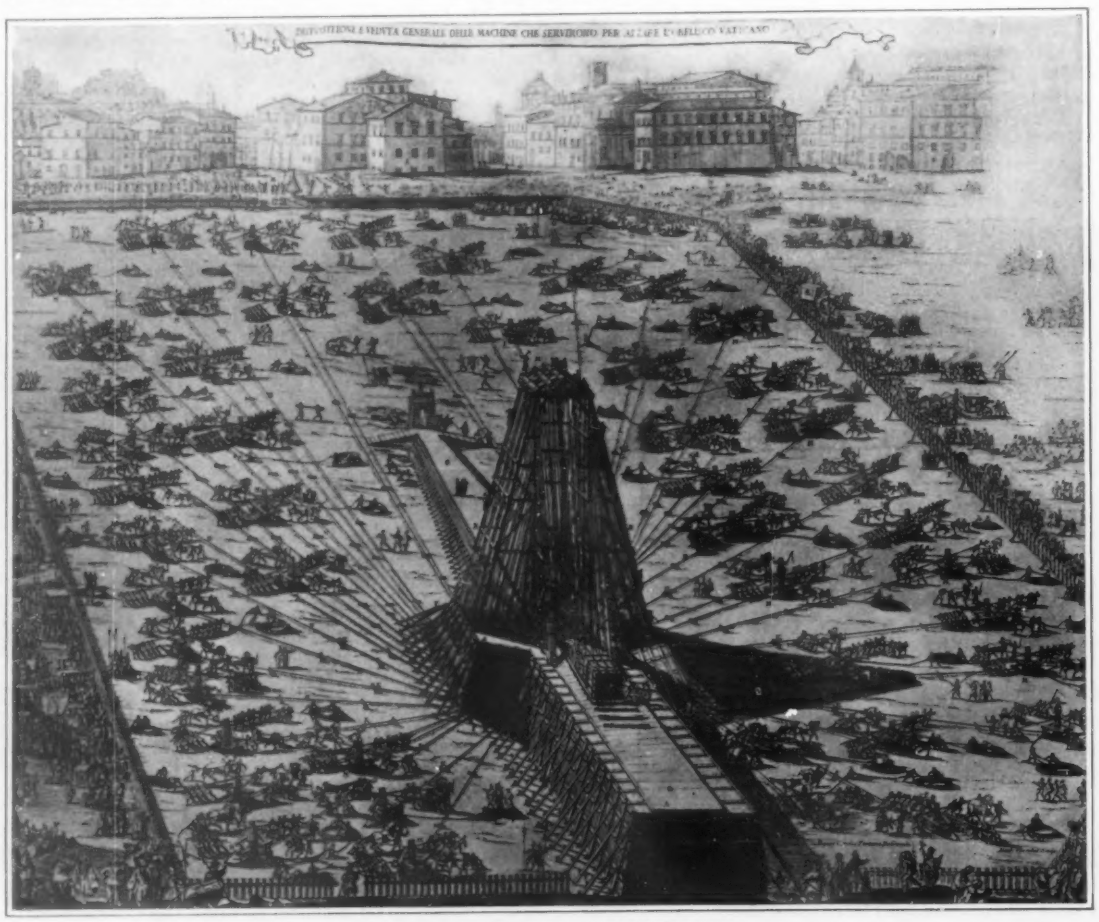


SIXTEENTH CENTURY ENGINEERING

Eight hundred men and one hundred and fifty horses raising St. Peter's obelisk.

The Competitive Designs for the New Quebec Bridge

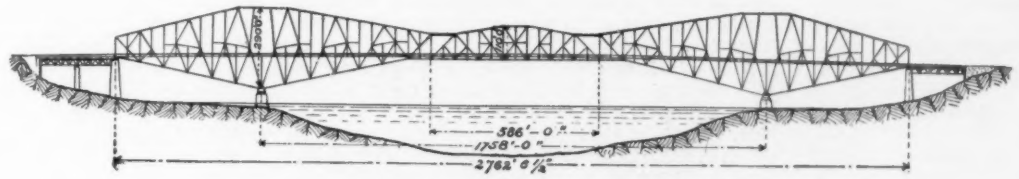
A Notable Competition Involving Thirty-eight Separate Plans

FINALLY, after the lapse of nearly three years' time, and the expenditure of several hundred thousand dollars in the preparation of plans by the Special Board that has been in charge of the drawing up of designs, the Canadian government has rejected all bids based on the plans of their Board and has accepted a design based on plans prepared by the St. Lawrence Bridge Company.

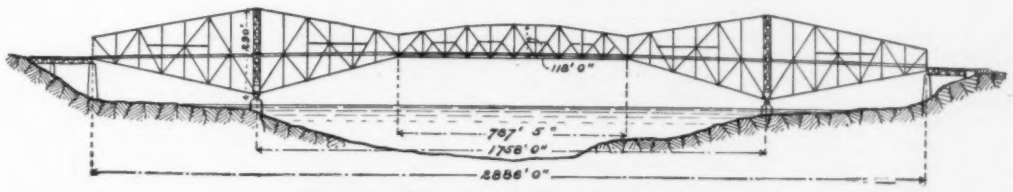
The SCIENTIFIC AMERICAN has taken great interest in this question of the new Quebec bridge, both because, in respect of the length of its main span, it is destined to be the most notable bridge yet constructed, and because we consider that it would be deplorable if the Canadian people, when carrying through their greatest engineering work, should fail to make it absolutely first class, both in design and construction.

The plan proposed by the government's Board of Engineers we have never liked. From the over-lightness of the old bridge that failed, the Board swung over to excessive weight and an extravagant use of material. Moreover, the general contour of their design for the bridge was not pleasing. In fact, as will be seen from the accompanying diagram, it lacked altogether a certain grace and harmony, which is present in the two other cantilever designs presented in our drawing, and is conspicuous in the suspension bridge proposed by the only competing American firm.

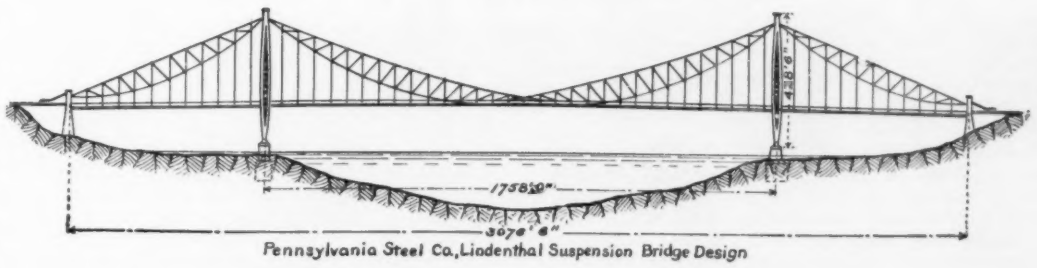
The tenders were based on plans and specifications of the Board of Engineers; but contractors were at liberty to submit tenders based upon plans prepared by themselves. The bidders were the St. Lawrence Bridge Company, of Montreal, who secured the contract; the Maschinenfabrik Augsburg-Nurnberg, A. G., of Gustavsburg, Germany; the British Empire Bridge Company, of Montreal, and one company from the United States, the Pennsylvania Steel Company, of Steelton, Pa.



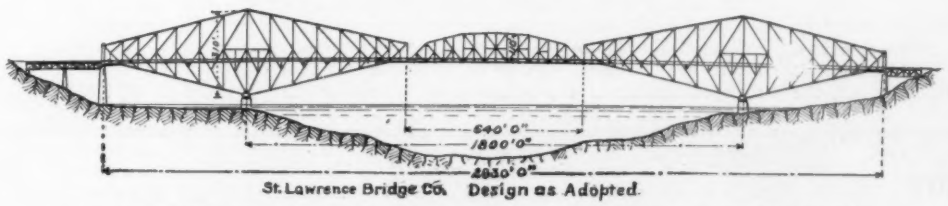
Board of Engineers, Quebec Bridge Design



Maschinenfabrik Augsburg-Nurnberg A.G.



Pennsylvania Steel Co., Liodenthal Suspension Bridge Design



St. Lawrence Bridge Co. Design as Adopted.

OUTLINES OF THE COMPETING DESIGNS FOR THE NEW QUEBEC BRIDGE

The plan of the government Board of Engineers called for a cantilever bridge in which the anchor arms and the cantilever arms, respectively on the shore and river sides of the main piers, were to be of the same length, and the middle suspended span, 586 feet in length, was to be erected by overhang, or by cantilevering out from the ends of the cantilever arms. The Board also prepared five modifications of this design, and a tender on any of the six propositions was considered a tender on the Board's design. In two of these schemes, the suspended span was to be erected by the overhang method, and the other four contemplated erecting the span upon pontoons and floating it into position. We show a design of their own, submitted by the German firm, the notable features in which are the unusually wide panels of the web system, and the great length, nearly 800 feet, of the suspended span. It was to be built of chrome-nickel steel, and the tension elements were to be built-up riveted members throughout. This firm also bid on three of the designs of the Board.

The British Empire Bridge Company put in six bids, all based on the designs of the Board of Engineers. They proposed to erect the central span by floating it into place.

The Pennsylvania Steel Company submitted ten tenders on the designs of the Board, and one tender for an eye-bar suspension span, the plans for which were prepared by Mr. Gustav Lindenthal, and which, from the standpoint of appearance, was unusually attractive. The successful bidders, the St. Lawrence Bridge Company, put in a bid on each design of the Board of Engineers, and also seven bids on designs prepared by themselves.

The accepted design received the approval of the majority of the Board, backed up by the experts appointed by the Canadian government. It was considered that there were several particulars in regard to erection which made the plan preferable to the Board's design. The bridge will have what is known as the "K" web system for the cantilevers, and a modified Pratt system for the suspended span, which is 640 feet in length. All the members of the anchor arm, and those standing immediately over the main pier, together with the floor system, will be built of carbon steel; and nickel steel will be used in the cantilever arms and the suspended span. The top chords will be composed of built-up riveted members.

It is a noteworthy fact that the successful design is not based upon either the plans or specification of the Board of Engineers, but upon entirely independent plans and specifications for a much lighter bridge of smaller capacity than that contemplated. The Board's design called for a bridge providing two railroad tracks, each capable of carrying an E-75 locomotive followed by a distributed train load of 7,500 pounds to the lineal foot; two 20-foot roadways loaded with 2,000 pounds per linear foot, and two foot paths. The successful bidders put in a tender for a much lighter bridge, from which the two roadways were omitted and the loading for the two railway tracks was reduced to an E-50 locomotive, followed by a load of 5,000 pounds per linear foot. Two foot paths were also provided. This great reduction in the loading necessarily led to the lightening up of the whole bridge, and a reduction of total cost, as is shown by the fact that the bids varied from $16,000,000 for the Board of Engineers' design to $8,650,000 for the design as above given, the total tonnage of steel required for the former being 148,000,000 pounds, and for the accepted design only 98,000,000.

Although the accepted design is superior to that of the Board of Engineers, we cannot regard it as entirely satisfactory when compared with the largest cantilever bridges already built in the United States. All three of these have been constructed across the Ohio River; and in general, they have an over-all length of 1,500 feet and a main span of 800 feet between towers. The last of these to be erected is that at Beaver, Pennsylvania, which was recently described in a paper read before the American Society of Civil Engineers. It is an exceedingly heavy structure, built for E-60 (6,000 pounds per linear foot of traffic as against 5,000 pounds on the accepted designs for the Quebec bridge). The Beaver Creek bridge is excellent in its details, in its adaptability for economic erection, and in its general appearance; and it is to be hoped that equal merit in these respects will be developed by the design which has now been adopted for the Quebec bridge.

The Eighth International Congress of Applied Chemistry

A PRELIMINARY announcement has been sent out of the Eighth International Congress of Applied Chemistry, which is to be held in Washington in 1912. The President of the United States has taken a great interest in this important event, and has consented to be named as its patron. He has further shown his solicitude for its success by inviting all the governments of the world to take part. On the council presiding over the affairs of the congress are many prominent members of the American chemical profession, the president being Dr. William H. Nichols, and the secretary Dr. Bernhard C. Hesse, both of New York city. Among the other members may be mentioned Dr. E. G. Acheson, Dr. L. H. Baekeland, Prof. W. D. Bancroft, Prof. Charles Baskerville, Prof. Bogert, Dr. G. F. Kunz, Prof. Charles F. Munroe, Dr. H. Schweitzer, and Dr. H. W. Wiley.

Natural Gas

THE natural gas industry of the United States in the year 1909 surpassed that of any previous year in quantity and value of the gas produced. The estimated value of the gas produced from wells and consumed in 1909 was $63,206,941, as compared with $54,640,374 in 1908, a gain of $8,566,567. This increase was due to several causes: To the increased demand for gas as a result of greater prosperity in the manufacturing centers of the country, following the depression in business and financial circles in 1908; to the completion of pipe-line systems and distribution in districts not heretofore supplied; to the advance in the price in some sections; and to the more complete canvass made of the gas producers.

With continued improvements in business, greater activity in drilling operations, and the completion of the new pipe-line systems under construction in 1909, the indications are that the output of 1910 should be even greater than that of 1909.

Anti-rolling Tanks for Steadying Ships at Sea

How Artificial Waves Are Made to Counteract the Waves of the Sea

ALTHOUGH the fore and aft motion (pitching) of a ship is more distressing to many passengers than the rolling motion, the latter is the cause of such general discomfort, to say nothing of seasickness, as to render the elimination of rolling a most desirable object. Furthermore, since most of the naval engagements of the future will be fought broadside to broadside, with the guns trained athwart the ship, any device which will eliminate rolling must have a most important effect upon the accuracy of gun fire. For the above reasons, it is not surprising to find that anti-rolling devices have been made the subject of much theoretical investigation and some very costly practical experiments.

The best known of these, bilge keels, are to be found on every ocean-going steamship. The bilge keel is a fin-like plate-steel structure, which projects at right angles to the ship's plating, and extends at the bilges (the point where the bottom of the ship rounds up to the sides) for about two-thirds of the length of the ship. They are arranged parallel to the longitudinal axis of the ship, so as to present the least possible resistance to progress. Although bilge keels reduce rolling, they by no means eliminate it, and, of course, their large surface develops a considerable amount of skin-friction resistance to the progress of the ship through the water.

Several years ago, that distinguished engineer, Thornycroft, designed and built an anti-rolling device, consisting of a very heavy weight, pivoted on a vertical axis and controlled by hydraulic power, which was moved from side to side in such a way as to counteract the heeling effect of the waves. It was fairly efficient in the ship in which it was installed; but its high cost and the considerable dead weight which had to be carried, prevented its adoption in commercial service.

That wonderful mechanism, the gyroscope, has also been called into service for the steadying of ships at sea. In this case, the resistance of the gyroscope to a change of its plane of motion is utilized to resist the tendency of the ship to heel under the action of the waves. Readers of the SCIENTIFIC AMERICAN have been made familiar with this device as worked out by Schlick, whose apparatus has proved very efficient in the ships of small size in which it has been installed. A recent improvement in gyroscopic control is that of Sperry, whose invention of what he calls the "active" gyroscope promises to provide, for a given weight of gyroscopic apparatus, a vastly greater controlling effect than is possible with the Schlick gear. Tests recently made by Naval Constructor Taylor, at the naval testing tank, Washington, seem to prove that this device will give a very complete control of rolling.

The earliest anti-rolling devices were of that type which forms the subject of the present article, namely, closed tanks of water built within the hull of the ship. In its simplest and earliest form, the anti-rolling tank consisted of a large, closed, rectangular chamber, built across the ship, and filled with water. The theory of these tanks was that when the ship, under the action of the waves, rolled, say, to starboard, the water in the tank would rush over to starboard; and that, as the ship, under wave action, rolled back to port, the body of water in the tank would lag to starboard, and tend to damp or check the roll of the ship to port.

Now it can be seen that the action of the water in the tank would be effective only if its rushing from side to side took place in a definite relation to the rolling of the ship. In other words, to check the ship's rolling the motion of the tank water must always lag a certain amount behind the rolling of the ship.

Now this was just what failed to occur in the early rolling tanks; and it soon became evident that some system of control of the tank water was necessary, which would insure that there should always be a surplus of water on that side of the ship on which the heeling effect of the wave, at any given time, was being felt.

As far back as 1883-5, Sir Philip Watts read before the Institute of Naval Architects, Great Britain, some papers describing experiments with an athwartship, water-filled chamber, which was installed on the old iron-clad "Inflexible." The trial of these tanks gave promising results; but it was impossible to control the water, and the size of the tanks was so great that they encroached upon space greatly needed for other purposes.

Of late years the investigation has been taken up by Herr H. Frahm, a German member of the Institution of Naval Architects, who read, at the last meeting, a most valuable paper, in which he gave a lucid account of the theory of the rolling tank, and exhibited diagrams of the devices by which he has overcome the difficulties experienced in the early "Inflexible" experiments. This he did by reducing the size of the tanks and placing the motion of the contained water under proper control.

Perhaps it will be as well just here to quote from Herr Frahm's paper: "This result has been obtained by the most careful application of the laws of resonance. . . . Under the effects of resonance, bodies that can oscillate about a condition of equilibrium are made to swing severely under comparatively small impulses, as soon as the period of oscillation of the impulse is synchronous with the individual periods of the respective bodies. A ship constitutes a body of this kind, as she will oscillate under the impulse of the waves. As is well known, a ship will roll almost exactly in the periods of her individual oscillations. . . . Large heeling amplitudes can be produced on a ship only if she is struck by a series of comparatively regular waves, and struck in the measure of her individual number of oscillations. Under such circumstances the influence of resonance will be promptly felt, and there will be an increase of the angle of heeling from wave to wave. All large rolling amplitudes observed in practical seafaring are due merely to the influence of resonance between wave and vessel. On this fact the present device has been based. It utilizes a secondary and artificial resonance in order to annihilate the influence of the primary resonance between waves and ship. This secondary resonance is introduced by means of a U-shaped tank, located athwartship and extending from side to side, in which a water column can oscillate with the same number of swings per minute that are peculiar to the ship herself. . . . The ship will heel only as far as the water, under the action of secondary resonance, rises or falls in the vertical tanks to such an extent that the heeling moment imparted to the ship by the waves is balanced by the opposite turning moment, produced by the oscillations of the water. The increment of heeling, from impulse to impulse, in a free ship, cannot take place now, and the rolling motions will be limited to such as will be sufficient to produce the necessary oscillations of the tank water."

In the earlier tanks a free wave rolled from side to side in an open chamber; whereas in Frahm's tank the water column is inclosed in a carefully-dimensioned chamber, where it performs uniform movements, which can be controlled by blocking the connections. The tank consists of two capacious chambers, one on each side of the ship, connected at the bottom by a shallow passage for the transference of the water. Curved diaphragms leading from this passage into the side chambers act as baffle plates to control the flow, and the air passage connecting the upper parts of the vertical tanks is provided with a throttling air valve, by which the passage of the air as it is forced from side to side of the ship by the rising and falling of the water can be obstructed with a view to adjusting the oscillations of the tank water to the condition of the sea. Also by closing the valve, the movement of the water may be blocked.

The first experiments were made on the passenger steamers "Ypiranga" and "Corcovado." These vessels are 447 feet long, and have a loaded displacement of 14,100 tons. The tanks are placed above the water line, as shown in our front page engraving, there being one forward and one aft of the amidship deck house. The total quantity of water in each tank is 94 tons. In rough weather during voyages from Germany to Argentina or Mexico, it was found that the rough-weather heeling angles of 11 degrees to either side were reduced, when the rolling tanks were in action, to only 2 degrees to 2½ degrees. On another occasion, when the tanks were out of action, the ship was rolling 18 degrees on each side of the vertical; but when the tanks were liberated the rolling reduced to from 3 to 4 degrees.

When the tanks are in full action, they exert a turning moment of 2,790-foot tons.

Correspondence

Why is Saccharin Valueless?

To the Editor of the SCIENTIFIC AMERICAN:

The recent decision of the United States Department of Agriculture in declaring one of the chemist's greatest discoveries as of no value is far reaching in its effect.

The use of saccharin as an economic sweetening agent in thirty or more food products is to be abandoned. Saccharin has been used to sweeten canned corn, peas, and tomatoes, sarsaparilla, cream soda, and other soft beverages; champagne and liquors. Its use will be unlawful after July 1st.

Dr. Wiley, Chief Chemist of the United States Department of Agriculture, appears to put little faith in the value of coal tar products, among which may be mentioned acetanelid, benzoic acid, vanillin, and the aniline colors, yet all these substances have been heralded as great economic discoveries. While the Remsen Referee Board has heretofore persistently disagreed with Dr. Wiley, it has delightfully agreed with him in the abolishment of saccharin, and has classed it as a worthless coal tar product.

We would not for a moment think that Prof. Ira Remsen, who is perhaps the most influential member of the board, could have his decision influenced by an incident which occurred in his laboratory some twenty-seven years ago, yet herein lies the history of saccharin:

In 1884 a clever student, while working for his doctor's degree at Johns Hopkins University, with the hope of preparing a new, but most likely unimportant, derivative of toluene, happened to taste his product and was surprised at its intense sweetness. Overcome with the visions of a fortune in its tremendous commercial possibilities, he completely forgot the professor who planned the research work laid out for him, and immediately resigned from the university. The professor was Ira Remsen, and the student a Dr. C. Fahlberg. This incident caused the wrath of Prof. Remsen, and a great outcry of indignation was aroused throughout the university world, which accorded all moral right of the discovery to Prof. Remsen. Dr. Fahlberg, however, secured all legal rights to the discovery by the granting of a United States patent to him on June 2nd, 1885, for the "manufacture of saccharine compounds." The patent was granted for the preparation of sugar compounds, the word "saccharine" being synonymous with sugar. In this process no sugar or sugar derivative is employed, and this is why Dr. Wiley deems packages marked "saccharin" misbranded. Rights of the manufacturers may be sustained from the fact that a final "e" is found dropped from the word "saccharine" when applied to the coal tar product.

Saccharin has a chemical name, benzoic sulfinide. It is extensively used, in households, to sweeten the food of diabetic subjects, an extremely small tablet being equal in sweetness to a large lump of sugar, when used in coffee, tea, or cocoa. Pure saccharin is 550 times as sweet as sugar. A sweet taste may be imparted to 70,000 parts of water.

But Dr. Wiley says this valuable substance impairs digestion, and should be dispensed only upon a physician's prescription. So saccharin must go, a valuable industry is destined to be ruined, and the chemist must search for a sweet coal tar product which will not impair digestion. We may not wholly agree with Dr. Wiley and the Referee Board, but hope that they have at least weighed the evidence of the other side in coming to so far-reaching a decision. But we certainly cannot agree with a New York daily newspaper, which brands the wonderful substances as "no good."

ALBERT H. WARTH, B.S.

Stapleton, N. Y.

Flags for Air Yachts

To the Editor of the SCIENTIFIC AMERICAN:

Through the columns of your paper I would like to suggest to all interested in aerial navigation that they use their influence to get the Government to adopt a special type of ensign for use on all aerial craft, or at least upon that class corresponding to the privately owned marine yacht.

As a suitable form of flag for this purpose, permit me to suggest an ensign similar in design to that known as the U. S. yacht ensign, but with one change, namely, that instead of the fouled anchor in the field there be substituted a two-bladed aerial screw in the ensign for aerial craft.

St. Louis, Mo. AMEDEE V. REYBURN, JR.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Hearing How Hot It Is

CYRO COSTA, an assistant in the polytechnic school of Rio de Janeiro, has invented a pyrometer based on the variation in the pitch of a musical pipe with change of temperature. The instrument (Fig. 1) consists essentially of two closed organ pipes or whistles *a*, *b*, attached to the ends of a tube *c*, which serves as a wind chase and is supplied with air by means of the lateral orifice, which communicates with a flexible tube terminating in a mouthpiece. A second flexible tube connects the ear of the operator with the lateral orifice of the wide tube *h*, which surrounds the tube *c* and the mouths of the whistles. The effective length of the whistle *a* can be varied by moving the piston *e*, by means of the rack *f* and pinion *g*. This length is indicated by a scale attached to the rack. All of these parts are attached to a cylindrical frame which surrounds the whistle *a* and terminates in a handle *n*. Fig. 2 illustrates the manner in which the temperature of a furnace is determined with the aid of the acoustic pyrometer. The end of the instrument to which the whistle *b* is attached is inserted into the furnace, while the whistle *a* remains outside the furnace. The length of the whistle *a* has been adjusted so that the two whistles shall be in unison when the desired temperature is attained in the interior of the furnace. The stoker sounds the two whistles simultaneously by blowing into the mouthpiece connected by a flexible tube with the wind chest *c*. If the pitch of the hot interior whistle *b* is lower than that of the cold exterior whistle *a*, the furnace is not hot enough; if *b* is higher than *a*, the furnace is too hot. The approximation to unison is announced by beats which can be recognized by any one. If the pyrometer is used by a person endowed with musical sensibility, the whistles can be sounded separately by providing the tube *c* with a central partition and two orifices communicating by two flexible tubes with a double mouthpiece, either side of which can be stopped at will by the tongue, while the operator has both hands free for the manipulation of the instrument.

The portable pyrometer, the description of which is quoted from *Le Génie Civil*, is inserted into the furnace from time to time, during the firing. In another form of the apparatus, shown in the upper part of Fig. 2, the whistles *a* and *b* are attached to the outer and inner surfaces of the furnace wall and are blown continuously by compressed air, which enters through the orifices *d d*, so that any change in the temperature of the furnace is instantly detected. As in the portable instrument, the length of the exterior whistle *a* is regulated by means of a rack and pinion and a scale.

Either form of the acoustic pyrometer can be used to measure the temperature of a furnace or other inclosure as well as to announce the attainment of the temperature desired. The temperature at any moment is measured by adjusting the length of the exterior whistle until the two whistles are in unison. According to the law which governs the velocity of sound in gases, the temperatures outside and inside the furnace are then proportional to the square of the effective lengths of the exterior and interior whistles. The length of the interior whistle is practically constant and known, the external temperature is also nearly constant and can be determined by a detached thermometer. From these data and the scale reading of the exterior whistle, the temperature inside the furnace is easily computed, and even this simple calculation can be dispensed with if the scale of the exterior whistle is so graduated as to give the internal temperature directly.

The acoustic pyrometer must obviously be made of materials such as platinum, carborundum and silundum, which are not affected by high temperatures. Silundum is especially suitable for the construction of the tubes.

The acoustic pyrometer compares favorably with other pyrometers in point of accuracy, especially at very high temperatures, and it presents the advantages of remarkable simplicity, almost perfect security against derangement, and the possibility of giving continuous indications at a distance to a large number of workmen. The ear is so quickly educated that a little practice makes it easy to distinguish the sounds of different instruments, so that one person can attend to several pyrometers and furnaces.

Fig. 2

Fig. 1

HEARING THE HEAT OF A FURNACE

Modern Light-proof Wall Paper

MOST wall papers soon change color under the influence of light, either fading or turning brown. The latter change is due to the presence of wood pulp, and is most conspicuous in wall papers which are not completely covered by the printed design. Fading is due to the employment of colors which are bleached by exposure to light.

The attempt to produce brilliant effects at small cost has led to the employment of wood pulp and fugitive colors, but it is possible to obtain light-proof wall paper by exercising caution in purchasing and paying a good price.

The question, in so far as it concerns the German wall paper market, was discussed by Dr. Paul Krais at a recent meeting of the Wurtemberg Chemical Society. An abstract of Dr. Krais's address, which was published in the *Zeitschrift fuer angewandte Chemie*, is here presented:

Modern wall papers are of several kinds, which differ in the method of production and also in price. German wall papers have a uniform width of about 20 inches, of which about 19 inches are printed, leaving a half-inch blank margin on each side. English wall paper is 22½ inches wide. The paper is made and printed in rolls either 4,000-5,000 feet or 23,000-25,000 feet in length, but is sold in rolls of 26 feet in Germany and 36 feet in England.

The three principal varieties are "natural," "ground" and "ingrain" papers. A fourth variety, "velvet" paper, is now little used. In natural wall papers the design is printed on paper which is either white or is tinted uniformly throughout its mass by distemper colors mixed with the pulp, while in foundation wall papers a uniform ground color in distemper is applied to the white or tinted paper before the design is printed. Ingrain paper is made on a duplex paper machine by which a layer of ordinary pulp is combined with a layer of pulp covered with fine wool fibers. The wool side of the paper is colored on the same or a special machine, and the design is printed in transparent colors, or glazes.

Ordinary wall paper is printed with pastes composed of pigment, water and gelatin or casein. The printing is done with wooden cylinders on which the design is engraved or outlined by brass wire and foil. Large areas of the same color are fitted in with felt for the purpose of holding the paste. One printing cylinder is required for each color, and the paper is passed several times through the printing machine for the production of special effects.

Satin papers go through a brushing machine before printing. Gold and bronze effects are obtained by using metallic pastes. Damask, moiré and relief effects are produced by passing the paper between a hard metal cylinder, on which the design is engraved, and a soft roller, made of compressed paper.

Salubra, lincrusta and leather papers are printed with oil paints and varnishes. In making salubra paper, a coat of light-proof oil color is applied to a specially prepared parchment paper, and the design is printed on this ground in other light-proof oil colors. A pressure of 230 atmospheres, with which any desired relief effect can be obtained, is employed in printing. Paper made by this method is much more durable than common wall paper, and is almost light-proof. It can be washed more easily and safely than a coat of oil paint, and, unlike the latter, does not crack. A variety of salubra paper, called tekko, is recommended as a substitute for textile wall hangings. Tekko is printed on parchment paper, with metallic powders, so colored and prepared that they are light-proof and do not tarnish in the air. Relief effects are also introduced.

In velvet paper, also called velours or beaver paper, either the whole surface or a pattern is covered with an adhesive and sprinkled with fine wool fibers. Intermediate between ordinary wall papers and the heavy water-proof papers described above are the papers printed thinly with oil colors by lithography or otherwise, which are produced by a few firms.

The wall paper industry is less than 100 years old, and the general use of wall paper began with the invention of the printing machine, in 1852. Early wall paper was printed with hand blocks, and was too costly for common use. Some fine wall papers are still printed by hand.

The industry is now one of great importance. Germany alone possesses 60 wall paper factories, 21 of which are associated in a trust. The industry gives employment to a great many workers, and it requires much technical and commercial ability. Changes in public taste cannot be foreseen, and a rash manufacturer is apt to find himself overstocked with undesirable patterns, which must be sold at a loss. The lowering of prices by competition is not the only reason why most wall papers are not light-proof. The general desire for striking and gorgeous effects is only too easily gratified by the employment of cheap, brilliant and fugitive aniline colors.

In recent years the efforts of the Duererbund and other associations, and of individual artists and decorators, have begun to effect a reform in public taste and to inculcate a knowledge of the qualities, and especially the fastness of color, which should be demanded in a paper for which a good price is paid. The makers of aniline colors were well aware of the degradation of their industry, and they have expended much money, labor and skill in efforts toward improvement. These efforts have so far succeeded that it is now possible to obtain aniline colors sufficiently light-proof to meet all reasonable demands.

The production of light-proof wall papers is attended by serious difficulties. Fast colors are much more

costly than fugitive colors, and the manufacturer's loss on unsold stocks is correspondingly increased. Furthermore, not every fast color is suitable for wall paper printing, and colors which are light-proof when used separately may prove fugitive when mixed. Great care must be exercised, also, to prevent the accidental introduction of the fugitive colors which are necessarily used for the cheap wall papers made in the same establishment.

A wall paper which is sold as light-proof, at 35 to 50 cents per roll (in Germany) ought to show little change in five years, which is the limit to the life of a wall paper determined by considerations of cleanliness and hygiene, and changes in fashion and occupancy. The paper need not be free from wood pulp, if it is a ground paper, entirely covered with light-proof opaque pigment. Washable papers should last much longer than five years, but even this degree of permanence cannot be expected for a 4-cent roll of thin wood pulp paper, printed with the cheapest colors.

The Patent Expert

IN a paper on the patent expert, read before the American Society of Mechanical Engineers, Mr. E. W. Marshall pointed out that in the present method of patent litigation, an important part is played by professional witnesses, designated more or less improperly, "patent experts." Many engineers are called upon, from time to time, to give testimony of this kind, and all are directly or indirectly interested in the judicial determination of the question involved. "The true status of the patent expert," says Mr. Marshall, "is not that of a hireling without conscience, who can frame his opinions according to the wishes of his employer, and who, under oath, can say whatever he likes for or against the cause, according to the side which engages him. . . . In presenting a case to a judge . . . the terms of the patent should be defined for him, its claims interpreted, and its relation to the art to which it pertains explained by those familiar with the scope and meaning of claims, and acquainted with the art in question. For this purpose only are patent experts engaged.

"Experts are obviously partisans . . . in the sense that they exercise their entire ability to set forth every fact which . . . may be fairly construed to be of advantage to their side of the case.

"An expert is a man instructed by experience. He must possess such peculiar knowledge and skill attained by previous habit or study as to make him more capable of forming a correct judgment upon a subject matter than an inexperienced person.

"The method of taking depositions follows federal law and practice. The expert's testimony is taken in any suitable place before a duly appointed examiner, in answer to questions. The examiner usually disappears after he has sworn the witness, leaving him at the mercy of his counsel and that of the opposing counsel, who question him and cross-question him to their heart's content. Objections to questions or answers are put upon the record. Sometimes the proceedings are interrupted to argue an objection before a judge of a court, but usually the objection is entered and the answer made as if no objection had been raised. Theoretically, the judge is supposed to be uninfluenced by the answer if the objection is one which should be sustained. All of the testimony is printed and submitted to the court at the final hearing.

"In the first part of his deposition the expert gives his qualifications. He tells what his training and experience have been, any facts which tend to show that he is competent to assist the court, and that his opinions and especially the reasons upon which he founds his opinions on the questions at issue are worthy of consideration.

"If he is retained by the complainant, the expert explains the patent in suit and its claims, and points out wherein the alleged infringement lies, usually coupling the various parts of the infringing device or substance with the elements of the patent claims.

"The expert for defendant tries to set forth facts which tend to invalidate the patent or to limit its scope, and also to show non-infringement. It is to be borne in mind that all expert evidence is given for the purpose of enabling the court to determine matters of law and fact, not to usurp the functions of either court or counsel. Experts define terms of the art or the state of the art at any given time; describe machines, models or drawings exhibited; explain the operation, purpose and effect, and the differences which exist in various devices, or which are involved in their construction.

"The expert's deposition lays foundation for the counsel's brief. The judge probably reads but little of it. It is important to get in facts and statements in clear, concise language, as free as possible from technicalities, which can be used by counsel. There are two sides to every question. The expert who refuses to admit or concede obvious facts cannot hope to have the same influence as the one who shows himself to be broad-minded and fair. But in making such concessions great care should be exercised in selecting the terms of expression used, for lawyers are only too apt to take any of the statements removed from their contexts and to enlarge upon them for the purpose of impressing the court in a way far beyond anything intended by the witness.

"The witness will be interrupted by objections both to the questions asked him and to his replies. Unless he is familiar with the rules of evidence he should pay no attention to them. They relate only to legal technicalities. He should not regard them as personal, but should only follow the direction of his counsel. To be sure, impertinent personal remarks are sometimes addressed to the witness. These cannot hurt his case, nor should they hurt him. They can be best met by ignoring them, as their purpose is invariably to upset the composure of the witness.

"Cross-examination for some is an ordeal, for others a pleasure. It is usually a mental combat between the questioner and witness, and the wise witness will save some of his best ammunition for this encounter. There are many clever tricks of this trade. For example, a skillful examiner will start out with a line of seemingly irrelevant questions, with the ultimate object of cornering the witness. This may be likened to the moves of a chess player who is trying to get his opponent where he can checkmate him. The earlier in the game the witness can foresee what his ultimate purpose is, the better.

"Again, it must be continually borne in mind that the cross-examiner is trying to get material for his brief, and care should be taken not to make statements which can be misconstrued. The clever expert can get into this part of his deposition a great deal of good material for his side. We are assuming, of course, that the witness is on the right side of the case.

"An expert witness is not a fact witness. He is not, therefore, hemmed in by the great mass of rules of evidence which surround the witness who is testifying to facts as he remembers them. The expert witness may use notes, so long as they are prepared by him, as he need not rely upon his memory. This is because he discusses principles, quotes authorities, and sets forth reasons and conclusions, and the reliability of his memory is not brought into any such matters. Our courts have often encouraged the use of notes by experts because of the fact that carefully prepared notes facilitate the presentation of such testimony as they give, and aid in making it more logical and complete, thus enhancing its instructive value. Again, experts may be asked leading questions, a thing not permitted with fact witnesses.

"The patent expert differs from other expert witnesses in one essential particular. The ordinary expert witness deals almost exclusively with opinions. The value of his testimony rests entirely upon the weight of his opinion. He is asked to tell why he is qualified to have an opinion which is worthy of unusual consideration, but is not asked the reasons upon which he bases his opinion. But with the patent expert it is the reasons he sets forth, his discussions of facts upon which his conclusions may be based, or of those things which may support or justify a determination, that are of prime importance.

"The expert's part of litigation is of undoubted importance. Under present practice it is much abused. In presenting complainant's side of a case the expert testimony should be clear, concise, free from all irrelevant matter and as short as possible. Perhaps, then, the judge will read it. It takes more skill and more time to prepare a short deposition than a long one.

"There is more excuse for defendant to present more lengthy and exhaustive experting, as he must set forth every defense upon which he can rely. This makes it incumbent upon complainant to answer in rebuttal the evidence presented by defendant, if it is important, and introduces the temptation to increase the record unduly and overburden the court. With such a prolixity of opinions and evidence sustaining the opinions as thus get into the records we often find the object of the expert defeated, and instead of aiding the justice who has to decide the case, by making clear to him matters outside of his learning, we confront him with a mass of contradictory matter which only causes confusion.

"The tendency to overdo expert evidence is a thing which is to-day justly criticised. One of our prominent experts recently took up eighty pages of the record to prove that an electro-dynamic machine could be used either as a dynamo or as a motor, a point which had already been conceded by the other side. Judge Severens, in the case of the American Stove Company vs. Cleveland Foundry Company, 158 Fed. 978, after deploring the fact that the record of this case has been overburdened by a prolixity of expert testimony, said:

> It is not the province of a witness to advocate the cause of the party who calls him, nor to pass upon the questions of law and facts presented by the controversy. Frequently an expert witness may be of much aid to the court in explaining matters which can only be appreciated and understood by learning higher than the ordinary; but his province is to instruct and not to decide; and even the instruction is of uncertain value when it is colored from standing in the place of the partisan for one of the parties. Usually, the testimony of one competent witness on each side is enough to insure a full and fair elucidation of what is recondite in the case. The voice of a single teacher is worth more than a confusion of many tongues. And the expense is worse than useless.

"The status of the expert in patent litigation is of dignity and importance. If he is properly qualified his statements are of value to the court, and his opinions and conclusions, if supported by facts and by reasons, must necessarily have weight and influence. The expert has been called an auxiliary counselor, and although this term is perhaps not well chosen, it suggests the importance of thorough understanding and complete co-operation with the counsel with whom he is laboring.

"It is instruction the court desires from the expert, and therefore clear, concise and simple statements in logical order are of greater value than a great mass of more or less irrelevant matter. And when these statements are upheld by the prestige of the man's own position and attainments, or are backed by citations from recognized authorities, the expert's testimony cannot fail to play the important part it should in patent litigation."

Smoke and Soot

A DARK cloud of smoke, with a sharply defined upper boundary, usually hovers over every large city in calm weather. In large factory towns the air is never free from smoke. No expert knowledge is required to comprehend the injury inflicted on the health of the inhabitants. This injury has rapidly increased with the development of manufactures, but, fortunately, the science and art of hygiene are developing at an equally rapid rate.

The approaching International Hygienic Exhibition at Dresden, from whose bulletin, *Hygieia*, this article is condensed, will contain many exhibits illustrating the enormous waste of fuel in improperly constructed and operated stoves and furnaces and the character and amount of the impurities which they discharge into the atmosphere. These impurities consist of unburned carbon, or soot, and of various poisonous gases, chiefly carbon monoxide, ammonia, and sulphurous, sulphuric and nitrous acids. The soot which, with condensed water vapor, constitutes the visible part of smoke, clogs the lungs, the poisonous gases act chemically on the blood, injure the nerves and irritate the delicate mucous membranes of the air passages and unfit them for their most important duty—the protection of the body against the germs of tuberculosis and other diseases.

The injuries inflicted on animal organisms by smoke and soot do not, as a rule, become well marked until the injurious influences have acted for a considerable time. In plants, the effect appears more rapidly. Conifers, in which the leaf surface is increased by subdivision into myriads of slender needles, have a hard struggle for life in the smoky air of cities. The leaves become coated with soot, which hinders transpiration and suffocates the plant. The injury is increased by acrid and poisonous substances, deposited with the soot, or acting in gaseous form.

Numerous devices for the rational combustion of fuel have been invented. By proper construction of grates, air passages and other parts of furnaces, careful selection of fuel, rational methods of stoking, and the employment of apparatus for the absorption and consumption of smoke, it is already possible to effect a considerable abatement of the smoke nuisance, with a corresponding economy in fuel. There is reason to hope that the nuisance will ultimately be entirely suppressed, and that our chimneys will discharge only the final products of complete combustion, carbon dioxide and water vapor. Meanwhile, devices for minimizing the injurious action of smoke by rapidly carrying it away and diluting it largely with air possess great interest. Some of these devices, including the Wislicenus "dissipator" chimney, will be shown at the Dresden exhibition.

The steadily increasing employment of gas and electricity for the production of heat and power is an important factor in smoke abatement. The comparatively few large gas works and generating plants in which coal is burned can be located away from congested districts and can be rationally operated and controlled more easily than thousands of independent furnaces.

A Wonderful Dinosaur Mummy

A Relic of the Prehistoric Past

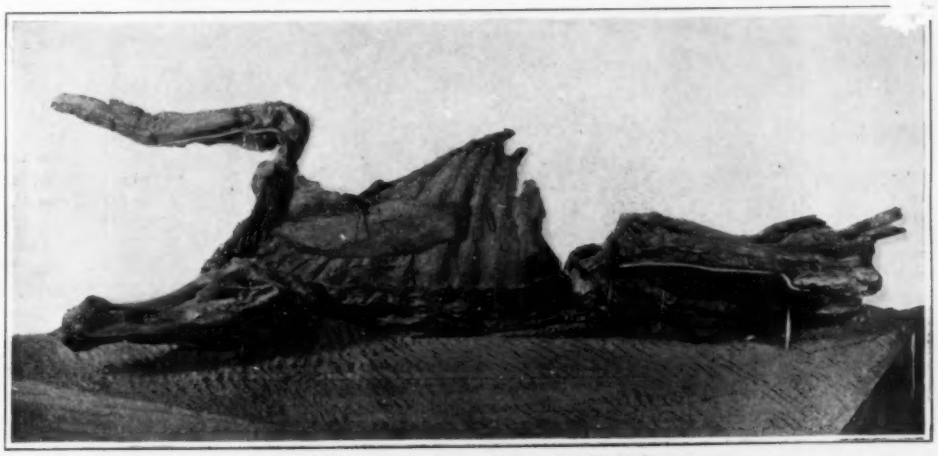
By Walter L. Beasley

AMONG the recent extraordinary fossil discoveries of the West, none is more marvelous and illuminating than the "Mummy Trachodon." In acquiring this great "find" and exhibiting the truly wonderful specimen Prof. Henry Fairfield Osborn of the Museum of Natural History, New York, has made a noteworthy contribution to paleontological science and has at the same time given a most impressive exhibit to the general public. In fact, the surprising revelations which have been brought to light by a study of this skeleton furnish a new and fascinating chapter which nearly doubles all previous knowledge of the habits and life of a very remarkable group of great amphibious reptiles. The important and valuable feature about this unique specimen is that it presents a complete cast, with absolute distinctness, of the hitherto practically unknown outer covering of these herbivorous dinosaurs belonging to the closing period of the Age of Reptiles. During the Upper Cretaceous Period, according to geological reckoning, about three millions of years ago, these huge kangaroo-shaped, water-inhabiting creatures were very abundant in western North America. They were from fifteen to sixteen feet or more in height, and measured some thirty feet in length. The skeletons, or hard parts, have been known for a number of years, having been found by Prof. Cope, the pioneer fossil explorer and scientist, and by others. The museum has mounted in its striking Trachodon group a fine Cope specimen, represented in feeding posture. Some half a dozen fragmentary specimens have been found showing faint areas of the epidermis, but the "Trachodon mummy" far surpasses all the others, as it presents a nearly complete and priceless picture of the pattern embossed upon the skin of these gigantic marine monsters. This fossil prize was discovered in August, 1908, by the veteran fossil hunter, Charles H. Sternberg of Kansas, and purchased by the museum out of the resources of the Morris K. Jesup Fund. One of the points upon which a new light has been shed by this specimen is the acquatic life habit of these animals. From the slight thickness of their skin it is inferred with great probability that their life was spent for the most part in the water. This theory is further strengthened by the fact that the diminutive fore limb terminates, not in claws or hoofs, but in a broad extension of the skin, reaching beyond the fingers in a marginal web, which connects all the fingers with each other, forming a kind of paddle. A new restoration of the Trachodon, which renders all previous ones obsolete, based on the mummy specimen, has just been made by Mr. Charles R. Knight, under the directions of Prof. Osborn. This strikingly shows the life appearance and the two characteristic attitudes commonly assumed taken by these creatures, and especially brings out the short dangling front legs, now known to have been fore paddles. From the fact that the lower side of the fore limb is as delicate in its epidermal structure as the upper, certainly tends to support the theory of the swimming rather than the walking or terrestrial function of this fore paddle.

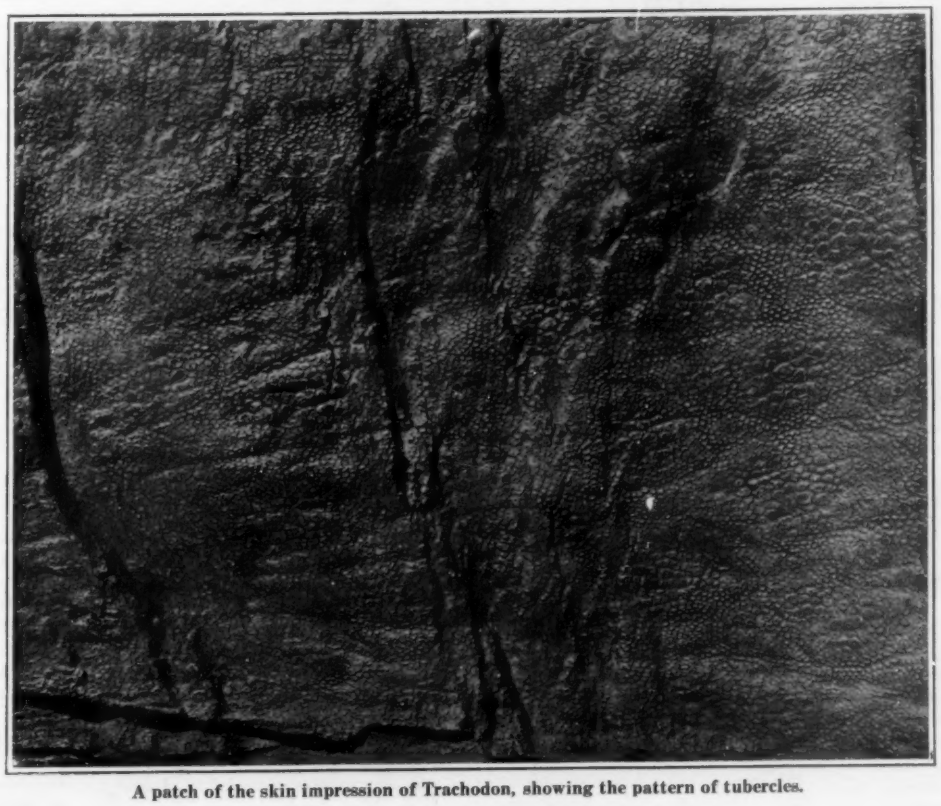
In Mr. Knight's restoration one of the Trachodons is pictured in the conventional bipedal, or standing posture, while the other is shown in a quadrupedal, or walking position, sustaining or balancing the fore part of the body on a muddy surface with its fore feet. In the distant water a number of the animals are seen disporting themselves. This specimen has been called a "Dinosaur mummy" from the fact that in all parts of the animal which are preserved, except the hind legs and tail, the skin is shrunken around the limbs, tightly drawn around the bony surfaces, and contracted like a great curtain below the chest area. Prof. Henry Fairfield Osborn, who is the foremost authority on the subject, has suggested the following interesting theory of the entombment and preservation of the "Mummy Trachodon." After dying a natural death the animal was not attacked or preyed upon by its enemies, and the body lay exposed to the sun entirely undisturbed for a long time, perhaps upon a broad sand flat of a stream in the low-water stage; the muscles and viscera thus became completely dehydrated, the epidermis shrank, and was tightly drawn down along all the bony surfaces and became hardened and leathery; on the

(Continued on page 518.)

Imaginary restoration of Trachodon in its characteristic erect and prone postures.



The "Mummy Trachodon" found in Wyoming.



A patch of the skin impression of Trachodon, showing the pattern of tubercles.

A WONDERFUL DINOSAUR MUMMY

Curiosities of Science and Invention

Gasoline-propelled Lawn Mower

THE German government has recently bought two lawn mowers which are propelled by means of gasoline engines. These mowers are used for cutting park lawns. The type of engine used is similar to that of an automobile. It is connected by means of a chain to a pair of traction wheels, on which the frame of the machine is supported. In addition to this there is a single wheel at the rear which may be turned to steer the mower. Directly in front of the traction wheel are the grass-cutting knives arranged in the usual spiral form. These knives may be adjusted up and down as in the usual lawn mower, and they are driven by direct connection with the motor.

Gasoline-propelled lawn mower.

Power-driven scissors-grinding outfit.

Motor Substitute for a Hand-car

HAND-CARS are now being displaced by motor cars on the leading railroads of the country. Through the use of these cars it is claimed that more work is performed by each man, due to the fact that he is set down at the place of work in excellent condition while with the old style car it is necessary for him to put forth almost enough effort for one day's work in propelling the car. The accompanying illustration shows such a car on the Pittsburg Wabash Terminal Railway which is propelled by a 3 horse-power gasoline engine. It is capable of developing a speed of 30 miles per hour on level track with five passengers.

Motor substitute for a hand-car.

Pipe made of red gum tree cone.

Swimming Lessons for School Children

THE accompanying photograph illustrates an apparatus in use in Germany for teaching school girls how to swim. The pupil is suported in such a position as to leave the legs and arms free to perform the motions of a swimmer. The body is hung in a wide belt, suspended from an overhead rail, while the feet are attached to a pair of ropes running over pulleys and adjustable to various requirements. The pupils thus suspended are then taught how to perform the movements of the breast stroke until the action becomes almost instinctive. There is a decided advantage in teaching these movements in such a way instead of in the water; for the pupil is not distracted by the fear of a ducking. It is not at all easy to learn the swimming movements even out of water, hence the advantage of acquiring this knowledge until it becomes almost instinctive before entering the water.

Teaching school-girls how to swim.

The Plumb-line in Porto Rico

AMONG the curious discoveries made by men of science in their innumerable efforts to measure and map the earth with the least possible error is that there are places where the direction of a plumb line is not vertical. Irregularities of density in the crust of the globe may produce this phenomenon. A remarkable instance in point was found in the island of Porto Rico, where the deviation from the vertical is so great that, in mapping the island, the northern and southern coast lines, as shown in the older maps, had each to be moved inward half a mile.

Weed cutter with the cutting frame raised.

Mowing Submerged Weeds

MANY of the lakes and creeks of Germany are so affected by the growth of weeds in the shallower waters as to interfere seriously with the catching of fish by means of nets. In order to clear the marshy bottoms of vegetable growth a weed-cutting apparatus has been invented. This is shown in the accompanying engravings. The apparatus consists of a boat on which is mounted a frame bearing at one end a set of knives like those of a mower. The frame is so mounted that it may be swung to the bottom of the lake and then the knives are operated by means of a hand wheel to cut the weeds. The boat is usually propelled by means of long poles. By operating another hand wheel the frame may be lifted out of the water and swung to the position shown in one of the photographs.

Mowing weeds from the bed of a creek.

Power-driven Scissors-grinding Outfit

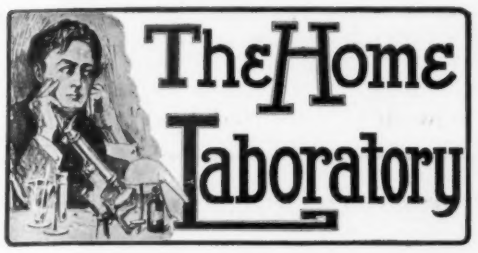
IN France even the scissors grinder takes advantage of the gasoline motor for relieving him of much of his labor in sharpening scissors, knives and other tools. The accompanying engraving shows such a motor-driven grinder in service on the streets of Paris. It is operated by a small single cylinder air cooled engine, mounted on the frame under the grinding table, the outfit is propelled by hand as a two wheeled cart.

Eucalyptus Tobacco Pipe

IN South Africa, where many species of Australian Eucalypti have been successfully naturalized, a curious use has been made of the cones of the red gum tree. These are of fair size and when the seeds have been shaken out resemble a cup in shape. It occurred to some ingenious person that the cones would make very good pipe bowls. A hole was bored in the base of the cone, and a piece of slender bamboo selected. When the two portions were joined together a very serviceable and novel pipe was the result. An experienced smoker declares the Eucalyptus pipe to be very agreeable in use, as the natural fragrance of the cone imparts a delicate fragrance to the flavor of the tobacco.

Canal Improvements in Germany

THE question of placing a tax upon navigation on the Rhine is being discussed in Germany, in order to meet the expenses of canal building and like public work. However, as the lower part of the Rhine runs through Holland, and that country will not admit the idea of such a tax, some other measures must be taken. It is thought that the solution of the problem would be to transform the Rhine into a purely German river as far as the sea. During a certain time it was considered that the best point to choose for the port at the mouth of the river would be the port of Emden, as the Dortmund-Ems Canal ends at this point, and this canal connects with the part of the Mittelkanal which passes from Dortmund to the Rhine. However, the port of Emden has not received the development which was expected, and the traffic of the Rhine-Westphalian region does not follow the direction of the mouth of the Ems. As regards the proposed canal, it appears that in former times the Rhine was connected with the Ems by a branch which bore the name of Eastern Rhine, but this branch no longer exists. The most recent project calls for the construction of the canal so as to restore the ancient branch of the Rhine, and it would start from Wesel, following along the Prussian frontier and connect with the Ems at Hannikenfahr. As it would run across a flat country for the most part, the construction would not present any difficulty, and as the land has but little value in these regions, the cost would not be high. Moreover, the proposed canal would need no locks along its course. Owing to the scope of the enterprise, however, the work would not cost less than $40,000,000.



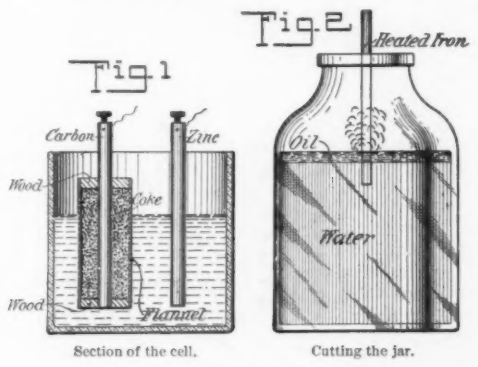
[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

A Seven-cent Battery

By W. J. C.

AN electric battery costing but seven cents can be made as follows: Procure a large glass or earthenware jar holding at least one-half gallon. If the top is not level or tapers, a glass jar can be cut level by the following means: Pour water in through a funnel to within one inch of the place where the cut is desired. Then, still using the funnel, slowly pour in linseed oil up to the level of the cut. A red hot piece of iron plunged vertically into the oil will cause the glass to crack at the level of the liquid and leave an open top jar suitable for the battery.

All the materials necessary for the battery are a



Section of the cell. Cutting the jar.

A seven-cent battery.

piece of zinc, a piece of arc light carbon, two circular pieces of wood about 3 inches diameter by ½ inch thick, some fine powdered coke, and some flannel. The illustration shows the method of assembling the parts. The wood has a hole just large enough to admit the carbon. The flannel is fastened, as shown, to the wood, forming a bag around the carbon in which the coke is packed tightly. The zinc and carbon can be held by any suitable means in the jar, and wires may be attached to the ends. The jar is filled about two-thirds full with a solution of 3 ounces of salamoniac to ½ gallon of water. The battery will be found very efficient owing to the porous carbon element.

Home-made Anemometer

By Frederick B. Gilbert

SINCE the introduction of the acroplane the anemometer has become very important in measuring the velocity of the wind before and during flights. The instrument as sold by dealers consists of a set of revolving cups or vanes which actuate a clock train and thus move hands around dials which indicate velocity and pressure. This instrument is rather expensive, so that amateur aviators, or other people who have occasion to use one do not feel that they can afford it. The anemometer described below can be easily made by any one possessing mechanical ability, and, if carefully constructed, should give good results.

It consists essentially, as will be seen from the figure, of a plate affixed to a shaft which is connected to a spring balance. The wind blowing on the face of the plate exerts a pressure which is transmitted to the spring balance and thereon indicated. Two interchangeable face plates of very light thin wood should be used, one 20 inches square for light winds and the other 12 inches square for heavy winds. The shaft is 15 inches long and affixed to the face plate exactly in the center. It should be as smooth as possible to eliminate much friction at the bearings; in fact all the working parts should be constructed with an eye to making them nearly frictionless. The bed of the instrument is about 10 inches long, 2¼ inches wide, and ¾ inch deep. The uprights are 3¼ inches high and the rollers ⅞ inch in diameter. Alongside the shaft and attached to the bed is a strip of wood cut so as to receive a paper scale over which a pointer on the shaft travels. The spring balance is attached under the shaft and arranged so that its action line will be parallel to the axis of the shaft. The best spring balance to use is one reading to ten or twelve pounds in as small ounce divisions as it can be obtained. The whole may be placed on a tripod, an old camera tripod answers very well, or it may be fastened to a stake. If it is desired to keep it constantly working a vane may be added to keep it faced into the wind.

The table below has been supplied by the U. S. Weather Bureau and gives the wind pressure in pounds for velocities from 5 to 90 miles per hour. Indicated velocities (velocities indicated by an anemometer of standard type) are given instead of true velocities. The difference is considerable. A

Wind Pressure (Pounds per Square Foot).

Indicated veloc.	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	.....	.....	.....	.....	.....	0.104	0.144	0.190	0.243	0.303
10	0.369	0.433	0.511	0.586	0.666	0.672	0.853	0.949	1.05	1.16
20	1.27	1.38	1.50	1.63	1.76	1.90	2.04	2.19	2.34	2.48
30	2.64	2.81	2.98	3.14	3.32	3.50	3.67	3.87	4.04	4.24
40	4.44	4.64	4.84	5.07	5.27	5.51	5.73	5.93	6.18	6.40
50	6.66	6.89	7.12	7.40	7.64	7.88	8.14	8.43	8.69	8.95
60	9.22	9.49	9.76	10.1	10.4	10.6	10.9	11.2	11.6	11.9
70	12.2	12.5	12.8	13.1	13.5	13.8	14.1	14.4	14.8	15.1
80	15.5	15.8	16.2	16.5	16.9	17.3	17.6	18.0	18.4	18.8
90	19.2	.....	.....	.....	.....	.....	.....	.....	.....	.....

To obtain the true velocity of the wind, the following formula may be used

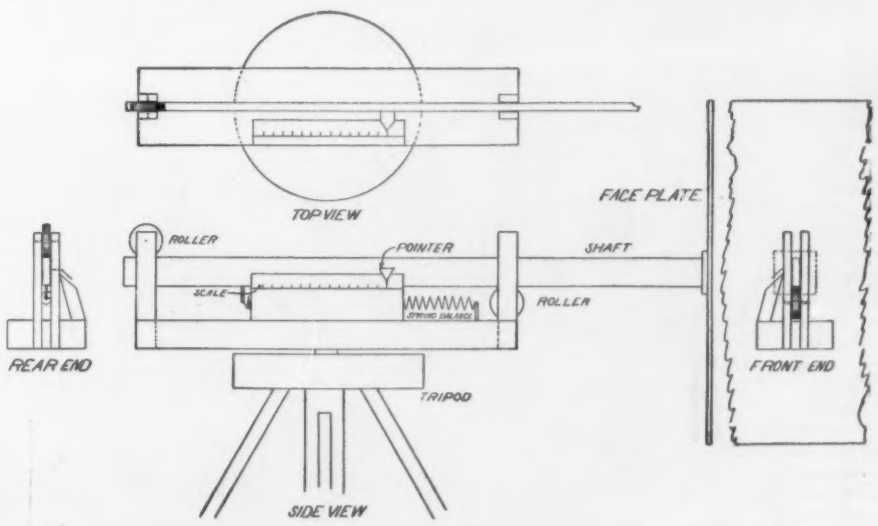
$$P = 0.400 \frac{B}{30} SV^2$$

where P = pressure in pounds, avoirdupois,
S = surface, in square feet,
V = corrected velocity of wind, in miles per hour,
and B = height of barometer in inches.

wind of 5 miles per hour indicated velocity would have an actual velocity of 5.1 miles. For 6 miles per hour the velocities true and indicated would be the same; but above this velocity the standard anemometer readings would be greater than the true wind velocity. For instance, 50 miles indicated would be 40.8 actual, 70 indicated would be 55.2 actual, 90 indicated would be only 69.2 actual.

By means of the foregoing table or the formula we can now graduate the anemometer to give indicated or actual wind velocity. For a given pressure on the spring balance we mark the corresponding velocity on the scale. Since we have two face plates of different area it will be necessary to graduate two scales, one above the other, making a reduction for the twenty-inch plate to a square foot surface. The best way to make the scale is to lay off with India ink on a strong piece of paper a scale with divisions equal in length to the divisions on the spring balance and to mark these divisions velocities instead of pounds. This division may be done with a pair of dividers. However, the dividers cannot be given a setting of the smallest division and then placed upon the paper and the scale laid off by walking them along, for when the end of the scale is reached it will be found to be far from correct with the one on the balance. The most accurate way is to lay off the total length of the scale, then if it is a ten-pound scale to lay off the five-pound mark in the middle, next the two and one-half-pound marks and so on down to the smallest divisions; thus the errors will tend to be self corrective. The scale is then glued to the instrument and covered with a coat of varnish to protect it from the weather.

It might be asked why a plate a foot square is not used exclusively, thus obviating the trouble of making changes and graduating two scales. The reason is, as may readily be seen from the table, that for light winds the instrument would not be delicate enough. For instance, a wind of 5 miles per hour produces a pressure of only 0.104 pounds per square foot, or 1.66 ounces, a pressure to which the instrument would not readily respond if only one square foot of surface were acted upon, whereas if a plate 20 inches square were used the balance would read 4.62 ounces, thus giving an appreciable displacement of the pointer and reducing the error of small readings. On the other hand too large a plate has the disadvantage of exceeding the limit of the balance in heavy winds.

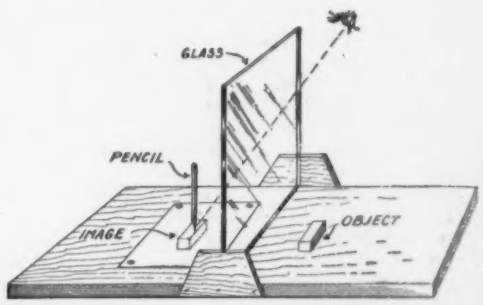


Apparatus for measuring wind velocities by determining wind pressures.

Drawing Solid Objects with a Reflecting Apparatus

By W. R. Ingram, M.D.

THE accompanying engraving depicts a drawing apparatus that may be familiar to many. It consists of a pane of glass set upright in a groove in a



Drawing an object with a reflecting apparatus.

board. A picture on one side of the glass, due to reflection, appears to cast an image upon the other side of the glass. By looking at this image and at the pencil through the glass a copy of the original can be made, the drawing, of course, being reversed. A drawing of this copy made in the same manner remedies the reversal.

It may not be generally known that the image of a solid object thus reflected is as easily traced. This idea will be of special value to an inventor who finds it difficult to make a perspective drawing of his model or some intricate parts of it. The method will be found much less troublesome than making a photograph.

In making a tracing by this means it will be found of great advantage to have a bright light on the picture or object to be drawn and a piece of cardboard arranged to shade the drawing paper.

A drawing is more quickly and easily made by simply marking the intersections of the different lines, and directions of curvatures, etc., after which the rest of the picture may be filled in with the aid of a ruler. If a very thin glass is used the double image, due to refraction, will not be confusing.

As a interesting experiment, take two blocks of identical size (so that reversal does not interfere). One of the blocks may be placed to coincide with the image made by the other block.

It would be interesting to hear from someone with a knowledge of clay modeling as to whether the model might be duplicated in this way (reversed, of course), excessive material being removed until the surface coincides with the reflected image of the object being modeled.

In making drawings in this way the writer several times caught himself reaching for the image instead of the real object, and was surprised to find his fingers closing on thin air. It was rather disconcerting until the mind had had time to grasp what had happened.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Coal Dust Engine

By R. W. Crowly

THOUGH yet in the experimental stage, the regenerative gas engine which burns coal dust as fuel has given results that promise well for larger engines of this type. As the working

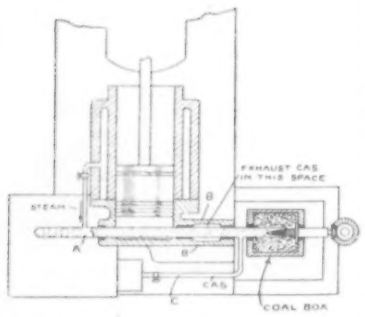


Fig. 2.—Plan view of the coal dust engine.

principles are so entirely novel, there is difficulty in finding a term which exactly expresses the nature of this simple engine. It is perhaps best named after its inventor, Mr. A. M. Low, for the Low engine is quite as distinct a type as the Diesel engine, though of course the comparison between these two names must not be taken to indicate any resemblance between the two engines. Setting out with the idea that he should find a method of reclaiming some of the waste heat of the gas engine, Mr. Low has virtually evolved a self-contained producer-gas plant and engine. In gas engines something like 80 per cent of the heat available in the cylinders is wasted either in the cooling water or in the exhaust. Very little of the heat is actually converted into mechanical energy. Regarded as a heat engine, the gas engine, though better than the steam engine, is still very wasteful. The best heat engine is the Diesel, which has a thermal efficiency between 35 per cent and 40 per cent, and it is extremely doubtful whether under any circumstances that high figure will ever be improved upon.

Mr. Low's working principles provide for the consumption of a fuel which is almost universally cheap; namely, coal dust. He has run his experimental engine on a consumption of about four pounds of coal per B. H. P. hour. As will be evident after the engine has been described in detail, a much higher efficiency would be obtained with larger engines and therefore it is not too optimistic to state that these engines will find an important place for themselves when designed upon a commercial basis. More than five years have already been spent in bringing the experimental engine to its present stage of development, and owing to the many alterations that have been made, many fittings being of a comparatively temporary character, the engine is not at all suited for accurate efficiency trials. A 40 horse-power engine is now in course of construction, and will shortly be available for a complete series of tests.

Referring to the illustrations of the experimental engine, Fig. 1 shows a view taken just above the back end of the cylinder. The fly-wheel is visible, the crank can be seen partially, but the connecting rod is entirely hidden. In so far as the moving parts are concerned the engine differs in no way from the ordinary horizontal gas engine. The distinction is in the regenerative parts. The inventor takes up a portion of the waste heat by means of a series of tubes passing through the compression space and arranged with one end projecting, as shown in the illustrations, into a box which contains coal in the form of dust, while the other ends of the tubes are closed to the atmosphere by a water seal.

When the engine has been started and is running, the tubes are heated to a dull red. As the fuel passes through the first portion of the tubes it becomes heated, the intermittent combustion which is taking place in the cylinder on each working stroke giving regular increments of heat which maintain the tubes at a working temperature. The fuel is heated sufficiently to drive off most of the coal gas. The tarry and carbonaceous products pass along farther, until, when they reach the part of the tube surrounded by the combusion chamber, they are at a high temperature. In each tube on the water seal side is fixed a pipe from which steam, taken from the jacket, and air, can be injected through the hot coal. In this way water gas and air gas are produced. In the tubes and just outside the coal box a second set of pipes is fitted, passing over the water seal and thence directly to the inlet valve. Thus, as soon as the coal dust is formed and the gas cock opened, the mixture of coal gas, water gas and air gas is drawn into the cylinder with its mixture of air, and fired in the usual way.

Ordinary bituminous coal broken up into small pieces is put into the actual container indicated in the general view of the engine. Coming away from this coal container in the direction of the engine are four pipes (*A* in Fig. 3). On leaving the coal box, they pass first of all through an extension box *B* of the engine, then right through the combustion chamber and out again on the other side, and thence down to the water seal. The coal is fed into the pipes *A* by a bevel-driven archimedean screw feeder (Figs. 2, 3), the speed of the drive being variable. The function of the water seal is that if perchance any coal dust should pass along to the end where the tubes bend downward, and not be gasified, it will fall into the water and may thus be removed when desired. The pipe from the inlet valve of the engine connects to this chamber, as also do the small pipes *C*, which communicate with the pipes *A*. Through the former pipes *C* the gas is drawn off from the hot coal contained in the latter, *A*.

Simple though the whole engine appears when described and illustrated, the fact that it runs with such a low fuel consumption as four pounds per B. H. P. hour is not to be doubted. In this connection Mr. Low writes: "I must point out that the engine is bound by its very nature to be efficient. Not only is 'waste' heat used, but the engine can be run very hot and with a high compression without any pre-ignition (the combustion chamber of the engine illustrated is asbestos lagged), and as the gas is kept comparatively cool by mixing, we have the best conditions of high thermal efficiency.

"Large single engines can easily be built on this principle, as the combustion chamber surface can be increased and cooling obtained to any desired extent, for it is possible to run with the fuel really hotter than the tubes by injecting the steam under pressure. The fuel temperature is high and the coal is cracked so quickly that all by-products can be passed through the engine over the water seal and discharged, the exhaust being slightly white and rather pungent. After weeks of running no trace of any tar or other matters can be found, neither is any pitting of valves to be detected."

Safety is another point on which this flash engine scores, as there is never any explosive gas present except in the engine itself, and there is nothing to cause any danger at all, for the fuel is consumed as soon as it is made. The engine is extremely flexible, which is a point of no small importance where engine work is concerned; an increase of power of about 15 per cent can be obtained almost instantaneously by shutting off the steam and air supplies and running the coal pumps faster, while admitting more extra air, thus making the engine run on coal gas pure and simple, largely increasing the effective pressures.

Of course, the important fact which must be mentioned in order to satisfy curiosity is that the engine works. A very eminent English engineer who saw the engine before it had run, made the curious remark that if that particular engine would not work, the bigger engine would certainly work well. The explanation is, of course, that the volume of the combustion chamber increases with the cube of the diameter, while the cooling surface of the walls increases only with the square. Dealing with the larger engines, therefore, one obtains a far greater proportion of combustion volume; from which it follows that a bigger tube heating surface can be obtained. So it is a very curious feature of the engine that the regenerative process becomes more and more advantageous the bigger the engine power. And as it is precisely in the treatment of the waste heat that difficulty is obtained with big gas engines, this is a very important feature. Remembering how the Diesel engine was scorned upon its first appearance and noting the great vogue it has now obtained, one can safely foresee that the Low engine is destined for a great future.

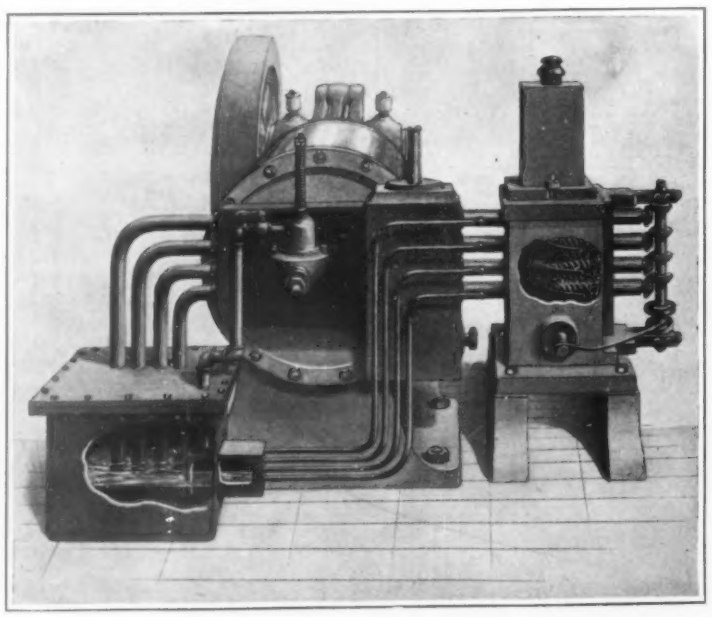


Fig. 1.—General view of the Low coal dust engine from the rear end of the cylinder.

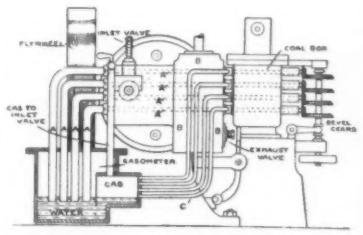


Fig. 3.—Rear elevation with parts shown in section.

Proceedings of the International Union for the Protection of Industrial Property

THE Conference of the International Union for the Protection of Industrial Property met in Washington on May 15th, for the purpose of considering amendments and revisions to the Treaty of Paris of 1883. Most of the nations belonging to the union have submitted propositions, and all of these will be considered during the sitting of the conference, the sessions of which are expected to occupy about six weeks. The meeting place of the conference is the New Willard Hotel, which placed its ball rooms and a suite of offices at the disposal of the union.

One of the principal disappointments of the conference was the inability of M. Henri Morel, Director of the International Bureau at Berne, to attend. He was prevented by illness from making the long journey from Switzerland. The vice-director, Mr. Leon Poinsard, arrived in Washington on the 6th of May and at once opened the headquarters of the conference at the New Willard. The preliminary meeting of the United States delegation was held in the office of Mr. Moore, the Commissioner of Patents, on the 13th instant, and a complete understanding was reached as to the policy of the United States toward the projects that are to be advanced by the conference. The President signed commissions giving the entire delegation plenary powers, as this is what is known as a "diplomatic conference."

The procedure of the conference is most formal. The delegations are arranged in the alphabetical order of the names of their countries, French being the language used. This puts Germany, or Allemagne, at the head of the list. The delegates are seated at the conference in the alphabetical order of their countries, beginning on the right hand of the presiding officer, without distinction of union and non-union countries. The acting director of the International Bureau occupies the last seat, thus being on the left of the president. Mr. Moore,

as chairman of the delegation representing the country in which the conference is held, occupied the chair at the opening meeting. After an address of welcome by the Secretary of State, Mr. Knox, the first business before the congress was the election of a permanent president. It being the custom of the conferences to select for this high office some retired diplomat, Mr. Henry White, formerly United States Ambassador to France, was designated by the United States government. The election of other officers, including a vice-president, followed, and the list of members of the board of secretaries was approved, as were also the rules designed to specify the procedure of the conference. All this was furnished by the International Bureau. Upon M. Poinsard and his staff, consisting of MM. B. Frey-Godet and Ed. Waelti, secretaries, and M. Louis Poinsard, private secretary, devolved the duties of reporting the sessions and keeping the records. The daily proceedings of the conference are printed each day in French and distributed to the delegates.

A list of the delegates appointed up to date was printed in the SCIENTIFIC AMERICAN of the 6th instant. Since then, Austria, Hungary, Portugal, Germany, Sweden, Tunis, France and Italy have designated their representatives. It was at first announced that Italy would not participate in the conference, but evidently the Italian government concluded that it would be to the best interests of that country to send delegates, although the International Exposition at Rome and Turin and various other congresses drew heavily upon the available scientists and experts. The Italian delegation consists of Nobile Lazzaro dei Marchesi, Marchesi Negrotto Cambiaso, Counselor of the Embassy at Washington, Engineer Emilio Venezian, Inspector of the Ministry of Agriculture, Commerce and Industry, and Dr. Giovanni Battista Cessato, Commercial Attache of Embassy at Washington.

The French delegation is composed of M. Lefevre-Pontalis, Counselor of the Embassy at Washington; M. Breton Director of the International French Property Office; M. Michel Pelletier, reporter of the Technical Committee of the National Industrial Property Office, and Mr. Georges Maillard, President of the International Property Association. For the Protectorate of Tunis M. de Peretti de la Rocca, First Secretary of the French Embassy at Washington, will act.

The King of Sweden has appointed his Minister at Washington, Count Albert Ehrensvard, to represent that nation, and Germany sent Dr. Haniel von Haimhaussen, First Secretary of the Embassy at Washington; High Privy Councilor of Government Robolski, reporting counselor of the Imperial Office of the Interior, and Prof. Dr. Osterreith, Secretary General of the German Union for the Protection of Industrial Property. The Portuguese delegation is composed of Viscounte de Alte, Minister at Washington, and Señor Urnesto Madeira Pinto, General Secretary of Public Works, Commerce and Industry.

The delegates of Austria and Hungary form two distinct bodies and vote separately. The Austrian delegates are Dr. Paul Chevalier Beck von Mannagetta und Lerchenau, President of the Imperial and Royal Austrian Patent Office, Privy Councilor of His Imperial and Royal Apostolic Majesty; Chevalier Phillipp von Stahl, Ministry Councilor of the Imperial and Royal Ministry of Public Works, and Doctor Emanuel Adler, Secretary of the Imperial and Royal Ministry of Public Works. For Hungary the delegates are Dr. Elemer von Pompery, Ministry Councilor Royal Hungarian Patent Office, and Dr. Constantin Kayser, judge in the Royal Hungarian Patent Office.

The Austrian Ambassador at Washington, Baron von Hengelmüller, does not appear in the conference as a delegate, but is instructed by his government to act as general representative when international agreements, binding upon the participant States and resulting from the deliberations of the conference, should come up for signature.

The Spanish delegation will be composed of the Minister at Washington, Señor Don Juan Riano y Gayangos, and Don Juan Plorez Posada, Director of the School of Industrial Engineers at Madrid. Brazil will be represented by Mr. R. de Lima e Silva, Charge d'Affaires of the Embassy at Washington. The Minister of Bolivia at Washington, His Excellency Ignacio Calderon, will represent his country at the conference.

Peru has appointed Mr. Emanuel de Freyre y Santander, First Secretary of the Legation at Washington, as delegate, and Liberia is represented by Mr. Ernest Lyon, Consul-General at Washington.

Owing to urgent parliamentary duties regrets were sent by Hon. Sydney Fisher, Minister of Agriculture, who is also Commissioner of Patents, and who had hoped to head the Canadian delegation, as announced. In his place was Mr. P. E. Ritchie, Registrar of Trade Marks and Copyrights of the Dominion Government.

Inasmuch as the deliberations of the conference are secret and the final texts of the treaties as amended are not given out until ratified by the various nations, it will be impossible to set down at present just what is being accomplished on behalf of the inventors and manufacturers of the world, but a still closer international amity with regard to the protection of industrial property is the inevitable outcome of this important conference, in which so great an interest is taken by the civilized nations of the globe that they have sent as representatives their most distinguished savants and men high in the realm of science and diplomacy.

Notes for Inventors

An Early Electric Automobile.—An early electric automobile is illustrated in the French patent to Grounelle, dated February 7th, 1852. The illustration presents a large four-wheel vehicle similar to a coach, with a number of transverse seats and without a top. Power is applied to the rear axle through diminishing gears from an electric motor of solenoid type, the current being furnished from a large primary battery (sulphate of copper) in a box at the front. For steering, the front axle turns about a vertical axis and a horizontal gear on the axle is meshed by a pinion on the lower end of the steering shaft which extends up and is provided at its upper end with a turning handle at the driver's seat.

Patents on Current Taps.—Three patents, 990,418, 990,419 and 990,420, have been issued to the Benjamin Electric Manufacturing Company, Chicago, Ill., assignee of Reuben B. Benjamin, for current taps for use in connection with lamp receiving sockets.

A Poet Patentee.—A gun was patented in the year 1718 in England to James Puckle, who termed it "A defence," and dropping into verse, says,

"Defending King George, your country and laws
If defending yourself and Protestant cause."

Puckle was evidently a religious enthusiast with by on means a gentle spirit, for he suggests a greater suffering for the Turks. In one of his drawings he shows a special plate for "shooting square bullets against Turks," while in another he shows a plate for "round bullets against Christians." The patent is of special interest as illustrating an early form of six shooter, seven shooter, and nine shooter. The chambers of the cylinder were to be revolved by a hand crank, being successively brought into registration with the barrel. The carriage or mount provides for the revolution and elevation of the gun proper, and appears to be well adapted for use in shooting flying machines. It is worthy of note that the mount of this early gun of 1718 more nearly approaches the carriages recently produced than those patented twenty or twenty-five years ago.

Legal Notes

An Action at Law for Infringement.—An interesting case is coming on for trial at an early day in one of the New York districts, in which the owners of an electrical patent have brought suit on the law side of the court for damages for infringement of the patent and the case will be given a trial before a jury.

Norling vs. Hayes: An Important Decision.—In the case of Carpenter vs. Skinner decided by the Court of Appeals of the District of Columbia, January 3rd, 1911, the court said: "It appears from the uncontradicted testimony of Skinner that he showed his invention to Carpenter who had ceased manufacturing under his patent. Within about two weeks thereafter Carpenter filed his reissue application with claims dominating the device of Skinner which was not an infringement of the patent. It is well settled law that to warrant the valid reissue of a patent, there must not only have been a mistake by the patentee, with no want of reasonable diligence in its discovery, but also that no third person has in the meantime acquired the right to manufacture and sell what the patentee has failed to claim. For the reasons given the decision will be reversed."

Shortly after the decision in the case of Carpenter vs. Skinner there came on for hearing in the same court, the case of Norling vs. Hayes, which the court decided May 1st, 1911, saying: "In the present case, a finding that a patent ought not to issue to Hayes, notwithstanding he is the prior inventor, in no way affects the sole question involved in the interference, namely, the question of priority; in other words, such a finding would not entitle Norling to an award of priority. Had the Commissioner ruled that the structure of each applicant contained patentable features, and that there was no interference in fact, and we had sustained the latter ruling, could it be maintained that either party would have the right, as against the other, to urge the bar of public use? Manifestly not. . . . . It should be remembered that this is not an infringement suit, but a proceeding under a statute which provides for the determination of a single issue, that of priority of invention.

"We conclude, therefore, that we are without jurisdiction in this proceeding to pass upon the question suggested."

In this same case of Norling vs. Hayes, the court referring to Skinner vs. Carpenter says: "In that case . . . . upon appeal to the court, the question of intervening rights having been raised below, and relied upon here, we ruled—Carpenter not being represented—that in the circumstances of the case, Carpenter was not entitled to a reissue of his patent and reversed the decision of the Commissioner. We did not, however, award priority to Skinner." The court then proceeded to consider the matter *de novo*, and said concerning the matter of intervening rights as above quoted and affirmed the decision of the Commissioner in the Norling vs. Hayes case.

The Patterson Case.—Chief Clerk W. F. Woolard, of the United States Patent Office, is now on a trip to Portland, Oregon, with papers from the files of the Patent Office for the purpose of testifying for the Government in the case of the United States against Patterson. This is Mr. Woolard's second trip to Portland in connection with the case.

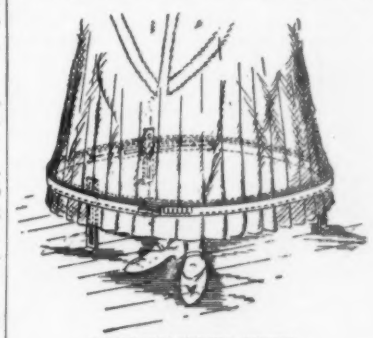
RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

BOOT OR SHOE HEEL.—N. B. ARNOLD, New York, N. Y. The aim of this inventor is to provide a heel having a tread partly made of leather and partly of rubber to prevent the wearer from slipping, to relieve the jar incident to walking, and to permit convenient removal of the rubber portion of the tread and location of the same at that part of the heel usually worn out first.

SKIRT MEASURING DEVICE.—SALLIE M. ALLEN, Poplar Bluff, Mo. An object of the invention illustrated herewith is to provide a device by means of which a skirt may be so trimmed that the bottom of the garment will be at the same distance from the ground all



SKIRT-MEASURING DEVICE

around the edge. Means provide that the skirt may be held in position while being marked. A further object is to provide a device by which the marking of the skirt may be rendered accurate. Mrs. Allen makes use of a perforated hoop for the perforations which form a guide for the chalk or other marking material.

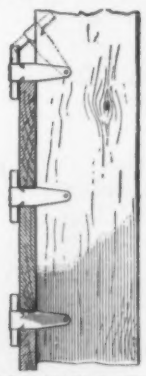
Of Interest to Farmers.

PLANTER.—W. C. THOMAS, Odessa, Del. This corn planter is adapted to plant one or more rows or hills of corn at a uniform depth at each trip across the field, and to level and pulverize the ground along each row. It is a conveniently operable and simple mechanism for raising the furrow formers and seed coverers from and lowering them to the ground.

PIANO CASING.—H. POHLMANN, New York, N. Y. The object of this invention is the provision of a new and improved casing, in which the keybed and keys held thereon can be readily removed from the piano frame, to allow of conveniently moving the piano in sections from one place to another, especially along narrow halls or up and down narrow stairways, etc.

CANE STRIPPER AND TOPPER.—H. T. BEAUREGARD, New Orleans, La. In this invention the improvement relates to a device for use in stripping the leaves from sugar cane and removing the tops or topping the same. This device is disclosed in this case as being connected with the mechanism for delivering the cane thereto as it is directly cut from the plant in the ground.

ANCHOR BOARD FASTENER.—RALPH E. ROBBINS, Hastings, Iowa. The invention pictured in the illustration is an improvement in corn crib constructions, and has for an object to provide a novel construction of what may



ANCHOR BOARD FASTENER

for convenience of reference be termed an anchor board fastener which will operate to space apart the adjacent boards or slats of the panel and will also operate to secure the boards in connection with the framing. The purpose of the invention is to provide a means to fasten and space apart the topmost boards or slats of the side walls or panels of a corn crib, furnishing a substitute for the nails as ordinarily used.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Earning Power of Your Money

You Get 3% to 5% on Loans and Bank Deposits. The Borrower and Banker Make 15% to 80% and Up. The Following Article Tells You How To Get What They Get. } Where Money Grows on Trees

Who is Using Your Money?

In these days of struggle to meet the demands of respectability and the high cost of living, one's savings are more than ever jealously guarded, and rightly so; speculation, however, tempting, is tabooed by the thoughtful.

First mortgages upon well located and improved income bearing property that offer possibly five per cent command much of the money. More, however, stays locked in safe deposit vaults or is invested in Government bonds, while that which is deposited in banking institutions is about as safe as it possibly can be, but in any event, the owners of moderate sums realize that it is slow work piling up fortunes, or even making a decent living from low rates of interest.

What is done with your savings after you buy a desirable mortgage that runs, say, for ten years, or after you deposit it in your bank for safe keeping?

The man who gives the mortgage and pays you the four or five per cent doesn't do it for fun, nor for love, neither does the bank pay you the three per cent upon your savings account out of mere good heartedness. That money must be made to earn the interest that is paid to you, also the cost of handling (reinvesting) it, and on top of these two items it must earn a very respectable surplus profit for the man or bank handling it. And as you hold the man's mortgage, he won't intentionally take any risk of losing the money, for then he would possibly lose his property; neither will the bank take any long chances with your money, therefore it is plain to see that the money you own as savings or otherwise acquired, when in proper hands, is made to earn far more than the little mite of three per cent bank interest or five per cent mortgage interest paid to you.

What Your Money Earns

How can the man who borrows from you and who gives you an A 1 mortgage and pays you five per cent, earn a fortune with the use of your money, or at least a very excellent income? How does the bank that pays you three per cent for the use of your money also pay its heavy operating expenses and possibly owns a magnificent building and also declares ten per cent to forty per cent dividends upon its capital stock each year? It is mostly done with your money, coupled with that of others, but the rate of interest return must be largely in excess of five per cent or six per cent.

You can do it yourself and make every $100 you have work for you twenty-four hours a day as long as you live and earn more and more each year for many years. This can be done without risking a single dollar and each dollar can be secured in a way that will be as safe as any first mortgage you can buy.

How to Get Full Earnings of Your Money

In the wonderful Bitter Root Valley—by many called the American Garden of Eden—the prize fruits, apples, charries, etc., grow in such abundance and of such remarkable size and luscious-

Palatial Home of Mrs. Marcus Daly, on 25,000 Acre Ranch in Bitter Root Valley, One of the Most Valuable Ranches in the World

ness, that they command the highest prices in the world's markets and earn a return for the grower that multiplies his original investment per acre almost beyond belief.

Suppose a particular piece of land is made capable of producing each year a net income equal to or larger than the original cost of the land and all development and improvement, which would you rather have, the total annual earnings of the land each and every year, or only 5 per cent. interest for loaning your money to some one who with YOUR money buys the real estate and reaps the larger reward, a return sufficient to repay the loan with interest and leave him with the property clear, from which he can enjoy a similar income annually?

The answer is clear, but there are thousands of people who stick to the 5 per cent basis because they don't know how to safely perform the other transaction and if told how and where it can be done, their timidity in many cases would still deter them from acting, even though they had every protection represented by a first mortgage.

It is on account of this peculiar condition with money savers that a corporation has been formed by experienced and reliable men through which they can invest their funds and enjoy what is virtually the protection of a first mortgage and yet receive in place of a low rate of interest the total profits which their money can be made to earn for them.

The Commercial Orchard Company of Montana has selected 500 acres of the "bench" land in the heart of Bitter Root Valley, from whence come many of the fancy fruit—apples, cherries, etc., you see displayed in the best markets, and much of which is shipped abroad.

The particular land selected is pronounced by authorities the finest for the purpose in the entire valley. As quickly as possible, the entire 500 acres will be set to such fruit trees as will produce quickly, the varieties of fruit for which a permanent demand exists and which command the highest prices.

Every detail of the work will be under the supervision of a thoroughly experienced horticulturist, and the result of so large a tract of land being operated under one management insures economy in development and the best returns during the season of shipping and marketing.

While it is proposed to operate this enterprise as a whole, each investor has the advantage of knowing that his or her money will be used in such a way as to multiply itself, and that back of each investment there stands as security a definite area of land which will be immediately cultivated and developed and which will stand as exclusive security for the particular investment, which security (or property) with its perpetual water rights is now worth several hundred dollars per acre and will rapidly increase each year in value as it is cultivated and its production increases.

Absolute Safety

The permanent value of such property and the enormous profits it yields, is attracting the attention of those who wish their **Independence Assured** and the man or woman who can own five or ten acres has no cause to worry for the future.

The best fruit lands of California, Idaho, Washington, Montana and elsewhere in the West where the world's fancy fruits are raised, is found in the valleys and at the base of mountain ranges. This latter land is best because it has the accumulation of the rich mountain soil washed down for ages. It is called "bench land" and when irrigated and set to fruit, it produces the prize products which sell for fancy prices at home and abroad. There isn't an unlimited acreage of such land and it is worth raw a high price per acre;—when cultivated and irrigated it becomes worth $5,000 per acre, and often much more, and earns annually from $250 to $1,000 net per acre.

Profits and Increased Valuation

Investors in this enterprise who act immediately and acquire their holdings upon the present low valuation will find that as the income from the property increases each year, the intrinsic worth of the property will increase in proportion. For illustration, when the net profit has reached 50 per cent per annum, the shares in the enterprise would have a value of five times their present cost; or, a

$ 500	investment	would	become	worth	$2,500
1,000	"	"	"	"	5,000
2,000	"	"	"	"	10,000
5,000	"	"	"	"	25,000

and as the profits increased above 50 per cent, the valuations would naturally increase in proportion, consequently the holders of shares in this enterprise would not only receive exceptional dividends, but because of same they would find that the security back of the shares they had purchased at the present low price would have increased in value according to the above illustration, and should they wish to dispose of same they would make the difference between the present purchase price and the value of the shares at the time of selling.

Investors Relieved of Personal Care

An 18-in. Apple Branch. The way they grow in Bitter Root Valley before thinned out.

The advantage of operating the entire 500 acres as a whole can be readily appreciated, but for the sake of illustration let us suppose this 500 acres was to be sold in 10-acre tracts to fifty different persons, and they all were obliged to give the care of their property more or less personal attention. About one in ten either by previous experience or education would know what was necessary to do; of the others many would insist upon having varieties of trees, etc., set that would not prove the most profitable or steady bearers. Some would neglect their interests, and all would have to assume the responsibility of individually looking out for themselves during the shipping and marketing season. Not one would have sufficient harvest to justify the expense of individually doing the one hundred and one things necessary to insure getting the highest possible market price for the individual crop even though they did make a handsome profit; whereas if all or more of the orchards are under a single competent management, every economy known to horticulture would be exercised and the aggregate harvest so handled as to insure the highest market price. The saving from such management will go in the shape of dividends to all shareholders in proportion to the holdings of each, without in any way detracting from the security back of each certificate of interest.

As an illustration of the worth of such property, aside from Government reports, and the actual experiences of the fruit growers in the Bitter Root Valley, some two years ago the Chicago, Milwaukee & St. Paul Ry., while building their extension to the Coast, cut through an apple orchard near Missoula, a thriving city in the Bitter Root Valley, and destroyed several trees. The owner sued the Railroad and was awarded judgment at the rate of $75 per tree.

This decision and the damages fined the Railroad was based upon the earning power of the orchard, which justified the valuation of $75 per tree.

The usual average is 88 trees to the acre, which gives a valuation to this particular orchard of $6,600 per acre—a valuation not at all unusual in this section.

A Rare Investment Opportunity

One of the many advantages of this form of investment is the fact that the investor not only enjoys his or her proportionate dividend return from the earnings of the property as a whole, but is secured against any possible loss by as many acres of land, under development, as the individual investment represents at the time of investing; with a further advantage of having the privilege of the property area represented by the individual investment deeded to the investor at some future date if the investor should prefer to own the property outright and reside thereon.

A $500 investment would represent one acre which would earn about 10 per cent per annum for the first four years from the cultivation of vegetables, strawberries and other products raised between the trees. After the fourth year the earnings would be upon the most conservative estimate, 15 per cent the fifth year; 28 per cent the sixth year; 60 per cent the seventh year; 80 per cent the eighth year, and so on up to the maximum earning power of the orchard.

These figures are based upon the lowest actual returns experienced in the Bitter Root Valley, where good management prevails. The reader can easily reckon the minimum return upon an investment of any amount from $100 up, but for convenience take an investment of $2,500, which would represent a 5-acre orchard, and this should return annually after the fifth year from $1,500 to $3,000—frequently the profits are larger. In one instance a cherry orchard produced at the rate of $3,200 per acre after paying all expenses.

The officers and directors of the Commercial Orchard Co. are all men of high standing in the business and professional world. They have made their investments in this enterprise for precisely the same reasons that you will likely invest your money—they want their money placed where its safety cannot be questioned and its earning power increased annually to the highest possible degree.

Investors who want practically the same security as a first mortgage, but who prefer to receive the **Full** earning of their money in place of the customary 5 per cent, should **Immediately** address the Chicago office of the Commercial Orchard Co., Desk 10, No. 9 South La Salle St., Chicago, Ill., for further particulars regarding this excellent opportunity. An investigation of same can certainly harm no one and is likely to result in increasing the happiness and income of those who may be permitted to participate in this particular enterprise.

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NEW BOOKS, ETC.

MONOPLANES AND BIPLANES. Their Design, Construction, and Operation. The Application of Aerodynamic Theory with a Complete Description and Comparison of the Notable Types. By Grover Cleveland Loening, B.Sc., A. M. New York: Munn & Co., Inc., 1911. 12mo.; 340 pp.; 278 ills. Price, $2.50 net.

It is with great satisfaction that the publishers of the SCIENTIFIC AMERICAN announce that at last they have found a manuscript on aerial navigation by heavier-than-air machines which is well worthy of presentation to critical students of aviation and the general public as well, for the book will interest each class of readers. Aviation is a predominant topic in the mind of the public and is rapidly becoming one of the greatest goals of development of the progressive engineering and scientific world. In the many books that have already been written on aviation, this fascinating subject has been handled largely either in a very "popular" and more or less incomplete manner, or in an atmosphere of mathematical theory that puzzles beginners, and is often of little value to aviators themselves. There is, consequently, a wide demand for a practical book on the subject—a book treating of the theory only in its direct relation to actual aeroplane design and completely setting forth and discussing the prevailing practises in the construction and operation of these machines. "Monoplanes and Biplanes" is a new and authoritative work that deals with the subject in precisely this manner, and is invaluable to anyone interested in aviation. Mr. Loening, who has come in intimate contact with many of the most noted aviators and constructors and who has made a profound study of the subject for years, is unusually well informed, and is widely recognized as an expert in this line. In a clear and definite style, and in a remarkably thorough and well-arranged manner, he has presented the subject of aviation. The scientific exactness of the valuable data and references, as well as the high character of the profuse illustrations and diagrams, renders this work easily the best and the most useful, practical, and complete that has ever been contributed to the literature on Aeroplanes. In the presentation of this book the publishers have spared no expense, and it is one of the most lavishly illustrated books ever devoted to the subject. A full list of chapters will be found in the advertising columns.

STANDARD PRACTICAL PLUMBING. By R. M. Starbuck. New York: The Norman W. Henley Publishing Company, 1910. 8vo.; 406 pp.; 347 illustrations. Price, $3.

Not only plumbers, but also house builders and house owners, may profitably con over the pages of so exhaustive a treatise. The illustrations, many of which are full-page, show the best and most modern practice in plumbing construction. Hot water supply and circulation and range boiler work are given very complete and practical treatment. Drainage, ventilation, filtration of sewage and water supply, and the water lift are dealt with in separate chapters. The system known as "continuous venting" is strongly supported and recommended by the author. It is his belief that the universal adoption of the system would constitute one of the greatest strides forward that has ever been taken in plumbing construction.

THE NEW ART OF FLYING. By Waldemar Kaempffert. New York: Dodd, Mead & Co., 1911. Price, $1.50 net.

In this book the principles of flying are reduced to their lowest terms, so far as popular expression is concerned. Without sacrificing in accuracy of statement, the author has explained in a very simple and clear way just why it is that a machine many times heavier than the air stays aloft at all; why it is so difficult to keep an aeroplane on an even keel; how that feat is performed; how a turn is made in the air; the principles of the aerial propeller; the difficulty of securing a light motor, and how that difficulty is overcome at present. Interwoven with the simple explanation of the principles of flight is a good deal of historical information of great interest and value.

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Vacant Regions of the Milky Way

(Continued from page 499.)

part of this description is true enough, according to Prof. Barnard, for this star is in one of the most remarkable of the blank regions of the Milky Way. Little, however, did Sir John dream when he spoke of the "intensely black ground" that Rho Ophiuchi was really the central point of a strong condensation of one of the most remarkable nebulæ in the entire heavens.

For many years this part of the sky attracted the attention of Prof. Barnard, until a photograph made by him, at the Lick Observatory on March 23rd, 1895, showed a vast and magnificent nebula in this region of the Milky Way. It was intricate in form, and apparently connected with many of the bright stars of that region, including Antares and Sigma Scorpii. The entire nebula occupies a vast vacancy among the stars here, from which lanes, absolutely devoid of stars, run eastward for ten or twenty degrees. From its dimensions, its individual peculiarities, and its occupation of a region almost devoid of stars, this nebula has scarcely an equal for interest in the entire heavens. To all appearances, the great nebula is located in a hole in a very dense part of the Milky Way.

The most singular feature, however, of the chasms visible in the Milky Way, is the presence within them of two gradations of obscurity, resembling the apparent blackness within the marginal umbræ of sun spots. The conviction is thus enforced that the Milky Way in the neighborhood of Rho Ophiuchi rests upon a far-reaching stratum of nebulous matter. Yet in regions thick with stars, such as are found in Ophiuchus and Scorpio, vacancies can be found within vacancies. "These regions," to quote Prof. Barnard, "seem veiled over with some sort of material in which occur blacker spaces, as if all this part of the sky were involved in a thin, faint, nebulous sub-stratum which partly veils the blackness of space beyond. In this, apparently, occur rifts and openings giving us a clear view of space."

It is, undoubtedly, by careful study of photographs of star-denuded regions, such as those taken by Prof. Barnard at the Lick Observatory and in the clear skies of Mount Wilson, California, that we can obtain some idea of their peculiarities which have an important bearing on the structure of the universe. These vacant regions are not merely curiosities of the sky, but actualities of the utmost interest, and as well worthy of study as the nebulæ with which they seem in many instances so intimately connected.

In fact, the connection of nebulæ with vacancies, and the apparent blending of the outer portion of the nebulæ with the darkness of the sky beyond as if that darkness were something really tangible, is an extremely important feature. Prof. Barnard is of the opinion that it may some day develop facts of the greatest importance in explaining the real structure of the heavens. For this reason, he is endeavoring to locate all these vacant regions of the sky, and to make long exposure photographs of them. In addition to the extraordinary regions of Ophiuchus, Scorpio, and Sagittarius already mentioned, he has succeeded in securing a photograph of an extraordinary region in Taurus. Narrow, vacant lanes tunneling a nebulous groundwork, seem to actually exist in this region independent of the stars. Besides the lanes, the photographs show a large nebula apparently in a hole almost devoid of stars, from which one of the lanes extends several degrees to the southeast.

Only a small part of the nebula is bright, the rest being feebly luminous like the dying embers of a fire. Possibly the hole and dark lanes may be the major portion of the nebula now dead or non-luminous. The picture conveys the idea that this non-luminous portion of the nebula "actually causes the apparent vacancy by cutting out the light from the stars." At any rate, this is what the picture suggested to Prof. Barnard, though he remarks, in an article published in the *Astrophysical Journal* for April, 1907: "I have been slow in accepting the idea of an obscuring body to account for these vacancies, yet this particular case almost forces the idea upon one as a fact. It almost seems to me that we are here brought face to face

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with a phenomenon that may not be explained with our present ideas of the general make-up of the heavens."

A Great Obelisk

(*Continued from page 500.*)

where it stood upon the "Spina." It is said to be the only monument in Rome never overthrown. It had been a Herculean job to get it there, but now, believing that it might be utilized to support a great cross as an impressive symbol of Christianity in a move against the paganistic relics of Rome, Pope Sixtus V. had it removed from its foundations in the Circus Nero to be set up in the great piazza in front of St. Peter's, under the direction of Domenico Fontana, and this master-workman was threatened with death should he fail to carry out his plans!

The transference of the tremendous block of stone was accompanied by some remarkable ceremonies, and an interest that was full of dramatic, almost tragic, intensity. It was placed on great rollers that had been carefully prepared and tested. Fontana superintended every detail in the lowering of the shaft, that was much more easily accomplished than the raising of it, as you shall presently see. And well might the task prove strenuous to Fontana, for was not there the penalty of his head should he fail? Eight hundred men and one hundred and fifty horses were employed in the transportation, and thousands of people watched every moment of its progress. All the preparations for hoisting the shaft when it finally arrived on the piazza were made with great care, and completed with much solemnity. Every possible expediency seemed to have been considered; and indeed, so far had everything been provided for, that the Pope issued an edict threatening death to man, woman or child who should utter a single word or manifest any excitement while the stone was being lifted into place, so fearful was he lest the slightest diverting of attention from the work, or annoying agitation by those surrounding it, might cause a fatal blunder.

Forty-six huge cranes had been put in place, at various points reckoned with skill and ingenuity. When all was ready the great square was covered at all sides, sufficiently beyond the working space, by a vast concourse of people. The neighboring housetops were also occupied, and Pope Sixtus and his officers of state and government held a commanding position.

Never had a greater crowd assembled in Rome. The silence of it was so awesome that there seemed to be something portentous and ominous to a degree of terror. Finally there appeared to be a concerted movement among the workmen, and the great hempen cables of the cranes were seen to tighten and then to move—and then the stone monster began slowly to rise. Everything seemed to proceed so victoriously that at last there appeared to be but a few inches to overcome when the shaft would find its absolute perpendicularity and settle on its new base—when the hoisting suddenly stopped! It was seen that the ropes were yielding! Fontana had neglected to allow for their tension. A feeling of personal dismay ran through the mind of every one. The situation was strained to a tragic intensity, but suddenly, in that deathly, silent suspense, a voice rang out:

"Acqua alle funi!"

It was a desperate cry from one of the multitude to *throw water on the ropes.* As quick as a flash the workmen seized upon the vital meaning of these words that hurtled like an arrow across the open space. The man that shouted them had no fear of the penalty—gave no thought to Sixtus—he was a sailor who knew his ropes and saw the only way out of an impending catastrophe.

Without an instant's delay bucket after bucket was carried from a nearby fountain and dashed upon the cordage. As the strands shrank under the inspired baptism they drew the obelisk into place.

The sailor's name was Bresca, and when Sixtus demanded at once his presence, he declared that as a reward, in spite of his threat, he and his family should have the privilege of providing the palms to be used at St. Peter's on Palm Sunday, so long as his family should last. And to this day in the old town of San Remo, where the Bresca people lived—on the Italian shore of the beautiful Mediterranean Sea, on the celebrated "Riviera"—most of the palms used in Rome and many other places in the Catholic world are gathered.

A Wonderful Dinosaur Mummy

(*Continued from page 505.*)

abdominal surfaces the epidermis was certainly drawn within the body cavity; while it was thrown into creases and folds along the sides of the body, owing to the shrinkage of the tissues within. At the termination of a low-water season, during which these processes of desiccation took place, the "mummy" may have been caught in a sudden flood, carried down the stream, and rapidly buried in a bed of fine river sand intermingled with sufficient elements of clay to take a perfect cast or mold of all epidermal markings before any of the epidermal tissues had time to soften under the solvent action of the water. In this way the markings were indicated with absolute distinctness. The outer covering or skin of the trachodons was of a thin character and made up, according to Prof. Osborn, of large and small size tubercles which varied in size and arrangement in different species. Associated with this varied epidermal pattern there was probably a many-colored surface design. The theory of a color pattern is based chiefly upon the fact that the larger tubercles concentrate and become more numerous on all those portions of the body exposed to the sun, that is, on the outer surfaces of the fore and hind limbs, and appear to increase also along the sides of the body and to be more concentrated on the back. On the less exposed areas, the under side of the body and the inner sides of the limbs, the smaller tubercles are more numerous, the larger tubercles being reduced to small, irregularly arranged patches. From analogy with existing lizards and snakes it is supposed, therefore, that the trachodons presented a darker appearance when seen from the back and a lighter appearance when seen from the front. The jaws of the large head were provided with a marvelous grinding apparatus composed of more than two thousand separate teeth, the most highly specialized known. The long, powerful, and compressed tail was used principally as an organ for swimming, acting as a propeller, and also served to balance the body when the animal assumed a standing posture. The trachodons had no protecting armament, and when pursued by the contemporaneous agile tyrannosaurus, king of the flesh-eating dinosaurs, found safety only in swimming far out into deep water. The "mummy trachodon" will be mounted in a glass case, when the visitor will be able by the use of a hand glass to study the finer details of the skin pattern. Of course, the actual skin itself has entirely disappeared.

Deviation of Bore Holes

(*Continued from page 500.*)

triangle whose base is the diameter of the ridges and whose vertical angle is the angle of deviation. But while the acid solution will enable the *amount* of deviation to be determined, it will not reveal the *direction* of it. When the tube has come out there is no record of how much it has turned on its axis, so that we are still somewhat in the dark. We know that the hole is bent, but which way—to due north, northeast, or to the west? In the same metal tube which contained the glass vessel etching liquid, a magnetic compass was placed and so arranged that a stop watch also included in the tube would fix its position at any predetermined time. It will now be understood that this arrangement would furnish a means of determining the orientation at the time of testing. The combined data would enable a very exact idea to be gotten of the course of the bore hole at the test point.

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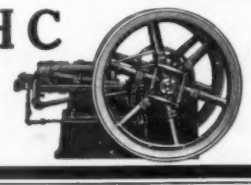

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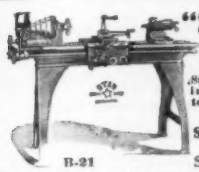

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netic needle. The upper and detachable bulb also contains liquid gelatine. Here, however, a very sensitive plumb rod of glass is immersed. The conditions of specific gravity are such that the rod assumes the vertical, however the tube as a whole is situated. This arrangement is lowered to the desired point and the gelatine allowed to cool and fix the position of magnetic needle and plumb rod relatively to the tube. When the apparatus is brought back to the surface in its container, the problem is to replace the tube in its position at the time of solidification. This could be done by simultaneously bringing the needle to bear north and the plumb to hang vertical. In effect this is done by means of an instrument called a *clinometer*. This is shown in the figure with the *clinostat* (as the gelatine tube is termed) placed in position upon it. At the upper part of the instrument are two microscopes. These are so arranged as to have their axes continually in a horizontal plane. The bulb of the clinostat containing the plumb line is placed at the intersection of the lines of vision. By the aid of vertical lines ruled on the object glasses the carrier of the clinostat may be variously inclined until the plumb becomes vertical. It remains now to maintain this inclination, whose amount may be read on the graduated vertical arc, but to adjust the tube until the needle is brought to a north position, or to effect an equivalent adjustment. The latter course is the one actually pursued. A horizontal mirror is rotatably arranged below the lower bulb. By adjusting this mirror until the needle gives an image parallel to a series of parallel lines ruled on the surface, the amount of horizontal deflection of the needle from the meridian may be determined. A horizontal circular scale facilitates this matter.

The inventor of this instrument is E. F. Macgeorge.

The first application was in connection with a bore hole in Australia. Upon the assumption that the hole was vertical, it was found impossible to find it by an exploratory level. By the aid of this device, it was, however, found at a depth of 370 feet. At this point the deviation from the vertical had amounted to 10 per cent of the depth. In fact, the next 130 feet increased the deviation to a total of 75 feet—15 per cent. The search cost altogether about $18,000. It is said that if the device had been available at the beginning, the cost of driving the level would have been only about $6,500.

Packing for Export

THE Bureau of Manufactures of the Department of Commerce and Labor has in course of preparation a monograph on packing for export. This monograph will be illustrated at great length and will include general instructions as to the character of packing for export, including criticisms of American methods, the general aspects of the problem, such as the responsibility for proper packing, means to guard against pilfering and recommendations as to the billing of goods and as the packing of various specified articles, ranging from shovels to automobiles. The monograph will also include extracts from letters by consuls and consular agents in the various foreign countries, and it is thought it will be the first publication ever issued bearing particularly on the subject of packing for export from the standpoint or viewpoint of the foreign consignee of the goods, so that it will give the shipper the exact information he may wish as to the manner in which the consignee desires the goods to be packed for shipment. It is thought the monograph will be ready for distribution in the course of six weeks or two months, and it should be a valuable contribution to the office library of any manufacturers or shippers.

New Seismological Station in Germany.—The rapidly growing *réseau* of seismological stations in Europe will include, after May 1st, a station at Königsberg, Prussia, under the direction of Dr. A. Tornquist, professor of geology at Königsberg University.

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Aeronautics

An Aerial Post in India.—Dr. Alexander Graham Bell has just returned from a trip around the world, which he made in exactly one year. In India he witnessed the trial of an aerial post, two mail bags containing 2,000 letters being carried across country by aeroplane to a central mailing point. He mailed a letter by this aerial mail route to his nine-year-old grandson, Melville Bell Grosvenor of Washington, D. C.

College Aero Club Meets.—The Yale Aero Club is holding a two-day aviation meet at New Haven, Conn., beginning May 18th. Glenn Curtiss, McCurdy, and Lincoln Beach are the chief aviators. The Harvard Aero Club expects to hold a glider meet at the aviation field at Squantum (near Boston), from the 27th to the 30th inst. There is considerable interest among the aero clubs of the various colleges, and all are trying to hold meets or have exhibition flights given in the near future.

The Death of Lieut. Kelly.—Early in the morning of May 10th Lieut. Kelly had been flying at San Antonio the recently-purchased Curtiss military biplane with success. He was obliged to alight upon a rather small spot, and in doing so descended at a sharp angle. He stopped the motor before striking the ground, but the force of the impact started it again and the machine rebounded and shot aloft, only to crash to the earth with terrific force. The lieutenant was thrown out and had his skull badly fractured, the wreck of the biplane falling upon him. He died in a few minutes.

Aeronautics in Japan.—According to the *Deutsche Zeitschrift für Luftschiffahrt*, the Japanese government spent 1,141,308 yen last year in connection with aeronautics. (A yen is approximately half a dollar.) Of this sum 471,209 went toward the expenses of two army officers who were sent abroad to study aeronautical methods and purchase aircraft. A large amount was also spent in laying out a flying field at Tukurosawa. This year a large hangar is to be erected, in which Baron Yamada's dirigible will be housed. Further sums are to be used in aiding Japanese constructors of aircraft, and in building a factory for military flying machines near Tokyo.

Two French Officers Killed.—On April 14th Naval Lieut. Byasson, one of the best and most prudent of the French officers interested in aviation, fell to his death near Rambouillet. Four days later Capt. Tarron also was killed. His machine dived to the ground, where it landed bottom side up, completely demolished. The aviator was found over 200 feet away. He had been instantly killed by the fall. Both these accidents occurred with Maurice Farman biplanes. It is impossible to attribute them to gyroscopic force developed by the motor, since a motor having stationary cylinders is used on this machine. Capt. Tarron had been experimenting and had replaced the broken tail cell of his machine with one taken from another, so that in his case the accident may have been due to some defect. In the case of Lieut. Byasson, all his fellow officers believe that the machine was to blame, as he himself was generally considered to be one of the most prudent men in the aviation corps.

More Aeroplane Fatalities.—The extended use of the aeroplane is resulting in bad accidents almost daily. On May 6th, at Shanghai, China, Aviator Réné Vallon fell to his death in a Sommer biplane from a height of over 600 feet. The accident occurred under perfect weather conditions, there being no wind whatever. M. Vallon shut off his motor and attempted a glide to earth at too sharp an angle. The machine struck the ground head on and overturned. The aviator was dead when taken from the debris. While testing the new "Canard" biplane (described in these columns a few weeks ago) early in the morning of May 8th, M. Say fell upon a house. The awakened occupants rushed out and picked him up, seriously injured. Three days later, at 5 A. M., Herr Beckmüller, a German aeroplane pupil, crashed into a house hidden by fog. His machine was demolished and he was killed. These are only a few of the more serious accidents which occur from lack of prudence and judgment.

Electricity

Parlor Car for Electric Railway.—A two-car train is soon to be used on the Illinois Traction System, which will consist of a motor car with library and buffet, and a trailer of parlor type with observation platform. This will make travel on the electric railway as comfortable as that on steam trains, with the further advantage that the passengers will not be bothered with cinders and smoke.

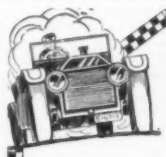
An Enormous Battery.—A huge storage battery is being built for the light and power company of Baltimore. The entire weight of the battery will be 540 tons, and it will be able to furnish 3,000 kilowatts per hour when fully charged. The battery will consist of 152 cells, each 150 inches high, 21.75 inches wide, and 6 feet long. Without the plates and the electrolyte the weight of each cell will be 940 pounds. Each cell will contain 133 plates.

Gasoline-Electric Car.—A gasoline-electric car was recently built for the Buffalo, Rochester & Pittsburg Railroad. This car proceeded under its own power from the shops at Schenectady, N. Y., to its destination, over the lines of the New York Central Railroad, making the trip of 225 miles without delay or trouble of any kind, and this furnished an excellent proof of its adaptability for general service. The power plant consists of a gasoline engine directly connected to an electric generator, which furnishes current for standard motors mounted upon the axles. It carries a storage tank for 100 gallons of gasoline, on which it can travel 200 miles.

Electrolytic Sewage Purification.—Oklahoma City is now using an electrolytic apparatus for the purification of its sewage. This apparatus is similar to that installed at Santa Monica, Cal. The sewage is conducted through flumes, in which are placed sets of iron plates, each measuring 10x24x¾ inches. There are three flumes, each containing ten batteries of 27 plates, and capable of purifying 250,000 gallons per day. The current used is about one ampere per plate. The action of the current is to cover the plates with bubbles of hydrogen and oxygen, which attack organic compounds and destroy bacteria. The cost of operating the plant at 4 cents per kilowatt hour is $2.16 per day.

Removing Lead Sulphate from Lead Plates.—A recent number of the *Electrical Review and Western Electrician* contains directions for removing lead sulphate from the lead plates in storage batteries. A set of plates had become coated with lead hydroxide, and had then been transferred to a bath of dilute sulphuric acid, where a coat of lead sulphate was soon formed. The acid was washed off in water, and then the plates were soaked in a solution of three parts water, one part ammonium hydroxide, and one part ammonium acetate, by weight. When the plates were clean they were washed thoroughly and immersed in a bath of sulphuric acid of specific gravity 1.1, and after remaining in the acid for an hour they were taken out and dried.

New Method of Forming Storage Battery Plates.—According to the *Electrical Review and Western Electrician*, a method of forming storage battery plates rapidly, has been developed in Germany. This consists of three operations, first to form a layer of spongy lead suboxide; second, to reduce the oxide so as to give negative plates; third, to obtain positive plates by transforming the metallic lead into peroxide. A bath of 10 per cent phosphate of soda solution is used to form the layer of oxide, and the plates are put between cathodes of equal surface, spacing by 0.4 inch, and working below 2.6 volt. The plates are soon covered with a layer of yellow oxide. To reduce this the plates are charged at one ampere per cubic decimeter in 1.18 specific gravity sulphuric acid, then after hydrogen is given off, the plates are washed for twelve hours. This gives negative plates. When positive plates are wanted, these latter are charged as anodes in 1.09 sulphuric acid at the same current density as above till all the oxygen is given off. From twenty-four to thirty-six hours' time is necessary.



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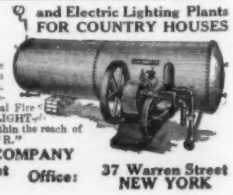

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By Grover Cleveland Loening, B.Sc., A.M.

Aviation is a predominant topic in the mind of the public, and is rapidly becoming one of the greatest goals of development of the progressive engineering and scientific world. In the many books that have already been written on aviation, this fascinating subject has been handled largely, either in a very "popular" and more or less incomplete manner, or in an atmosphere of mathematical theory that puzzles beginners, and is often of little value to aviators themselves.

There is, consequently, a wide demand for a practical book on the subject—a book treating of the theory only in its direct relation to actual aeroplane design and completely setting forth and discussing the prevailing practices in the construction and operation of these machines. "Monoplanes and Biplanes" is a new and authoritative work that deals with the subject in precisely this manner, and is invaluable to anyone interested in aviation.

Mr. Loening, who has come in intimate contact with many of the most noted aviators and constructors and who has made a profound study of the subject for years, is unusually well informed, and is widely recognized as an expert in this line. In a clear and definite style, and in a remarkably thorough and well-arranged manner he has presented the subject of aviation. The scientific exactness of the valuable data and references, as well as the high character of the innumerable illustrations and diagrams, renders this work easily the best and the most useful, practical and complete that has ever been contributed to the literature on aeroplanes.

Following is a table of the contents:

PART I.

The Design of Aeroplanes.

Chapter I. Introduction. II. The Resistance of the Air and the Pressure on Normal Planes. III. Flat Inclined Planes. IV. The Pressure on Curved Planes. V. The Frictional Resistance of Air. VI. The Center of Pressure on Flat and Curved Planes. VII. The Effect of Depth of Curvature and Aspect Ratio upon the Lift and Drift of Curved Planes. VIII. Numerical Example of the Design of an Aeroplane.

PART II.

Detailed Descriptions of the Notable Aeroplanes.

Chapter IX. Introduction. X. Important Types of Monoplanes. XI. Prominent Types of Biplanes.

PART III.

Comparison of Types.

XII. Comparison of the Prominent Types. XIII. Controlling Apparatus. XIV. Accidents. XV. The Variable Surface Aeroplane. Index.

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Science

The Libyan Desert to Be Explored in an Airship.—It is stated in *Petermanns Mitteilungen* that Dr. L. Seigert, the geologist, will shortly undertake to cross the Libyan desert in an airship. He expects, with the aid of the prevailing winds, to make the journey from the Mediterranean to the Nile in about thirty hours, passing over a region that is at present almost entirely unknown to geographers.

The Cruise of the "Carnegie."—The magnetic survey yacht "Carnegie," belonging to the Carnegie Institution, is reported to have reached Cape Town on March 20th. Since last June she had traveled about 1,400 miles in the Atlantic Ocean. Dr. Bauer, director of the Carnegie Department of Terrestrial Magnetism, who went to Samoa to carry on magnetic observations during the solar eclipse of April 28th, expects to join the ship at Colombo, Ceylon.

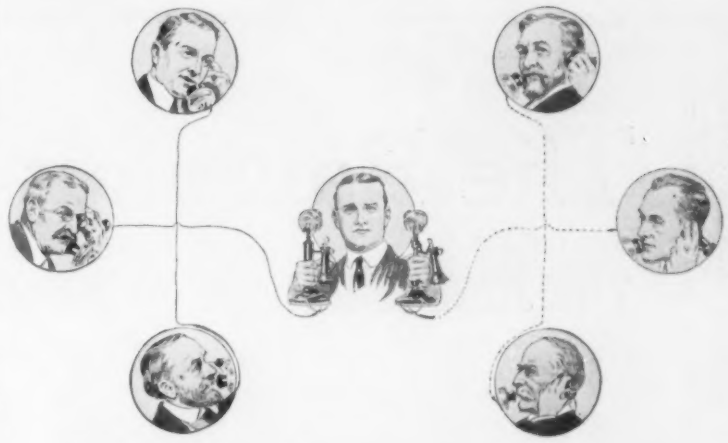
Exploration of the Benue.—It has taken sixty years to completely explore the great Benue River, the principal tributary of the Niger. According to the *Bulletin of the American Geographical Society*, the last unknown stretch of the river has been surveyed by Capt. Strümpel, in charge of German interests at Adamaua, Kamerun. Flegel discovered the headwaters of the Benue north of Ngaundere in 1882, and in 1893 Passarge extended the survey up the river from Garua to Bubandjika. Strümpel has surveyed the stream between its headwaters and Passarge's farthest.

The New Director of the American Museum of Natural History.—Dr. F. A. Lucas, who has been curator in chief of the Brooklyn Institute of Arts and Sciences since 1904, has been appointed director of the American Museum of Natural History. Dr. Lucas has rendered important services for the government in the fur seal controversy of the Bering Sea and in preparing exhibits for the National Museum at Washington. He is a thoroughly experienced, well-trained man, in every way qualified for the high position he is destined to fill.

The Yale Expedition to Peru.—Under the direction of Prof. Hiram Bingham, a party will leave Yale University on June 10th to carry on geographical, archæological and historical exploration in Peru. A cross section of the Andes will be made through a country that has never been scientifically explored and only mapped in the rudest possible way. The party, which will probably consist of a physiographer and geologist, a skilled topographer, an assistant topographer, and possibly a surgeon and naturalist, besides the director, expects to spend five months in the field.

Geologic Work of Ants.—Prof. J. C. Branner, in the *Bulletin of the Geological Society of America*, describes the immense importance of ants as geologic agents, especially in tropical regions. Ant burrows have been found at a depth of 3.5 meters, and they ramify over vast areas. The geologic work performed by earthworms has long been recognized, but Prof. Branner believes that the ants and termites of the tropics bring a greater amount of earth to the surface than do the earthworms of the temperate zones, and are in many ways an equally important factor in the changes that are going on in the upper strata of the ground.

Destruction of a Well-known Meteorological Station.—*Petermanns Mitteilungen* reports the destruction by fire of the first order meteorological station at Vassijaure, in Swedish Lapland. This station, lying well within the Arctic Circle (lat. 68 deg. 25 min.), was founded in July, 1905, with the aid of funds contributed by a number of scientific men, and its observations have been published in detail by the Royal Swedish Academy of Sciences. Many members of the last International Geological Congress, who took part in an excursion to this outpost of science, will regret to hear of the catastrophe that has overtaken it. There is a prospect that, instead of rebuilding the station at Vassijaure, a new station will be erected at the tourist resort Abisko, on the Torñe Träsk.



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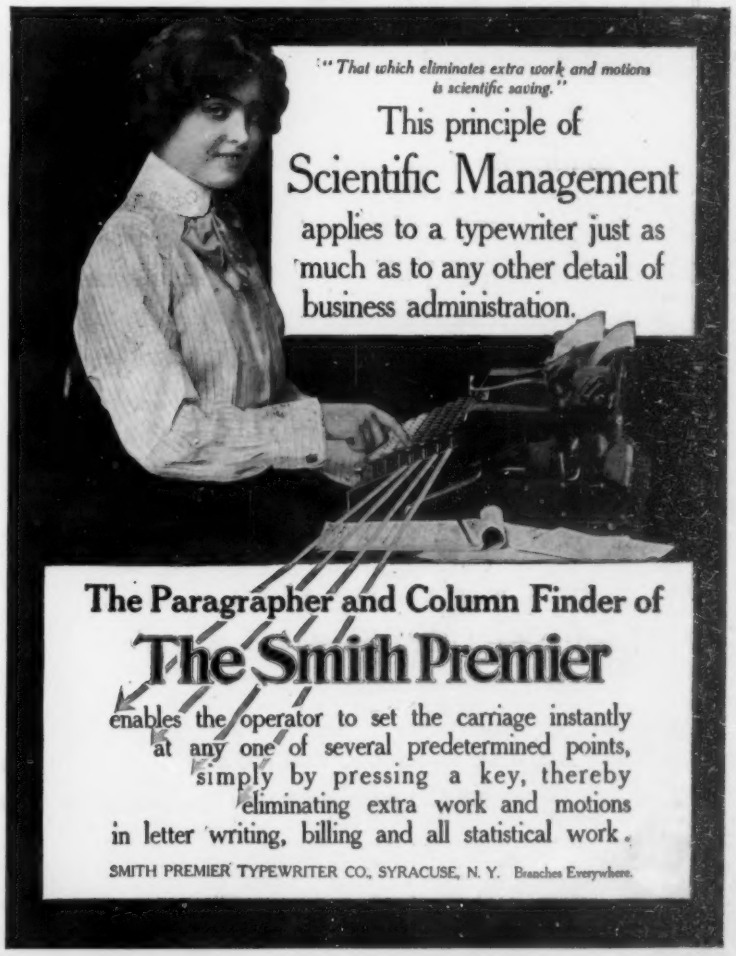
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The Railroads of a Continent

THE JUNE MAGAZINE NUMBER OF THE SCIENTIFIC AMERICAN ISSUE OF JUNE 17th, 1911

Transportation facilities and civilization go side by side—a people's means for getting about give a pretty good line on their development in other regards. For this reason, among others, we are devoting the greater part of the June mid-month number of the Scientific American to the story of that marvelous network of railroads, which, during the past three-quarters of a century, has been woven over the face of the United States and Canada.

We have all heard of the Interstate Commerce Commission; but how many of us know what it is, what it has done, and what it aims to do? These questions will be answered in an article by the able Chairman of the Interstate Commerce Commission, Judge Judson C. Clements. He will tell you what the Commission has done to make travel safe by the use of automatic couplers, the air brake and the block signal system, and how the Commission regulates rates and otherwise safeguards and harmonizes the interests, both of the public and the railroads.

In bygone years, there was much cause for the hostility of the public to the public carriers; but conditions have now changed for the better. To-day tnere is no reason why the public and the railroads should not settle down into an attitude of friendly cooperation. This, at least, is the conviction of the Scientific American; and it is shared by Mr. W. C. Brown, President of the New York Central and Hudson River Railroad, who will contribute a characteristically clear and forceful article on this subject.

One-half of the railroads of the world are to be found in the United States, and, as usual, we have stamped our individuality strongly upon them. The most picturesque and romantic element in our system is the half dozen great transcontinental routes, which span that wonderful stretch of plain and mountain that lies between the Mississippi River and the Pacific. The story of the transcontinental roads will be told by Mr. William E. Hooper, Associate Editor of the Railway Age Gazette. Not many people know on what a vast scale the railroads of Canada are reaching out into the undeveloped lands of our great neighbor to the north. This story in itself will form a chapter of thrilling interest.

It is a far cry from the little locomotive De Witt Clinton, of 1831, weighing six tons to the mammoth freight locomotive just completed by the Atchison road, which is 122 feet long and weighs 425 tons. The story of the growth of the American locomotive will be told by an expert historian, Mr. Herbert T. Walker. In the eighty years covered by this period, a search for the ideal locomotive brought out some curious freaks, among which was one with 10-foot driving wheels. The same author will write entertainingly on this subject, and a score of excellent drawings, made from early original manuscripts, will enrich the text.

The American railroad has always grown faster than its terminals; but we are to-day atoning for the neglect by building the most magnificent terminal stations in the world. The largest of these, the new Grand Central station in New York City, will be described and richly illustrated. The text will tell how the millions of the future will be daily received and distributed by methods that are entirely new in the railroad world.

Let it be understood that the above articles will be matter additional to the regular paper, which will contain the usual editorial, aviation, science abstracts, inventor's and other weekly departments.